THE

AMERICAN

JOURNAL OF SCIENCE AND ARTS.

[SECOND SERIES.]

ART. XV.—*A general Review of the Geology of Russia;* by M. E. DE VERNEUIL, delivered before the Geological Society of France on presenting in the name of Sir R. I. MURCHISON, Count A. VON KEYSERLING, and DE VERNEUIL, their joint work on the Geology of Russia.*

THE first volume of the Report on the Geology of Russia consists of two parts. The first is devoted to the physical and structural geology of the extensive regions of Russia in Europe; the second gives a detailed description of the Ural chain. This natural division results from the character of the country itself. In a geological point of view, there is the most striking contrast between the nearly level and flat regions, which constitute Russia proper, and the mountains which separate it from Siberia. Throughout the vast plains of Russia, except in the Donetz country, the most ancient rocks occur in a tender and loosely aggregated condition, lying in horizontal beds with hardly a trace of upheaval or metamorphism. In the chain of the Ural, on the contrary, the palæozoic formations have been subject to the most violent dislocations, being variously tilted, folded, and even overturned. The limestones are indurated and lose that light color for which they are so remarkable in the plains. Argillaceous schist and graywacke replace the clays and friable sandstones, and it is only by the fossils, some of which are common to both regions, that the paralellism of the beds can be established.

---

* *Geology of Russia in Europe and the Ural Mountains*, 2 vols., 4to. London and Paris, 1845: the first volume in English, the second in French.

This analysis of the work, by M. de Verneuil, has been translated for this Journal from the Bulletin of the Geological Society of France, by D. D. OWEN, Esq.

The first part of the work commences with an introduction, in which, after having adverted to the recent progress in the classification of the palæozoic deposits, the authors enter into some generalizations on its application to different parts of western Europe, and mention that they undertook the exploration of Russia in order to test the correctness of these views by observations over its extensive districts.

In accordance with their general plan, (which was to describe all the formations in the ascending order from the more ancient to the more recent,) the authors commence by a sketch of Scandinavia, where the fundamental rocks occur, on which the Silurian have been deposited. The most inferior beds of the latter system are characterized in Sweden, as in Russia, by *Asaphus expansus*, *A. Buchii*, *Illænus crassicauda*, and *Echinosphærites*, and, in the Scandinavian peninsula, they repose on gneiss or the more ancient schists, which the authors denominate *azoic* rocks. These last contain no traces of fossils, and it is probable that they were formed anterior to any trace of animated beings. They are completely unconformable with the inferior Silurian system, which is considered by its organic remains to be the equivalent of the most ancient fossiliferous beds known, i. e., those denominated by Sedgwick, in England, protozoic strata.

One of the most important results arrived at by the authors in their comparisons of the Silurian systems of Sweden and Russia, is, that, viewed on a great scale, they are divisible into two periods, each of which has its peculiar palæontological features. The inferior period comprehends all from the lowest fossiliferous rocks to the argillaceous and calcareous strata of the Island of Gothland. The superior epoch, but little developed in Russia, (except in the Ural,) embraces particularly the deposits of the Island of Gothland and Oesel, which represent the Wenlock and Ludlow limestones.

In the vicinity of St. Petersburg, the Devonian system succeeds immediately to the inferior division of the Silurian system, and is recognized at first sight by the great number of fishes which it affords. These fossil fishes, of which many are identical with species found in the old red sandstone of Scotland, are found associated with mollusca analogous to those of the calcareous beds of the Devonian system and those on the banks of the Rhine, and confirm the parallelism which the authors of the Devonian system have established between these beds.*

* M. de Verneuil has recently discovered in the Eifel, remains of the *Asterolepis* and *Coccosteus* and several other genera, associated with the well known shells of that country; one of these specimens sent to Prof. Agassiz has been described by him in his monograph of the fishes of the Devonian system, under the name of *Asterolepis Hœninghaasii*.

M. de Verneuil then called the attention of the Society to the immense development of the Devonian system in Russia. It appears, on one side, extending nearly to Voronez, and thus separates the carboniferous formation of Donetz from that of central Russia; on the other side it reaches towards the Teman Mountains, the basin of the Petchora and the Frozen Ocean. In these northern regions it presents nearly the same character which it has on the Baltic and the province of Valdai, and not the type which it exhibits in the Ural Mountains. It appears to be divisible into two epochs sufficiently distinct; viz., into the upper or fish-bearing red marls above, and the goneatite limestones and schists beneath, perfectly analogous to those of Nassau or Grund in the Hartz.

The carboniferous system is divisible in Russia into two natural regions. In the north and the centre of the country it is composed of horizontal beds of friable freestone, and black argillaceous beds, containing, here and there, a little coal surmounted by light colored limestone, sometimes magnesian. In the south, on the contrary, i. e., in the country of Donetz, it is much dislocated, and affords, as in the north of England, beds of good combustible coal, which alternate with gray, compact limestone, charged with marine fossils.

Above the carboniferous system is displayed a vast and powerful assemblage of deposits, (Permean system,) which occupy, in the government of Perm and the neighboring governments, an area greater than that of all France. They abut upon the flanks of the Ural but do not penetrate the interior of the chain, although elevated at certain points; their general bearing leads us to believe that the first upheaval of the Ural took place before their deposition and about the termination of the Carboniferous epoch. Their mineral composition varies along the line of observation. In every part of the Ural which forms a portion of the shore of the Permean sea, and one hundred and twenty-five to one hundred and fifty miles to the west of that chain, the predominating rock is the conglomerate of the red sandstone with minerals containing carbonate of copper disseminated. The copper is often concentrated in the beds charged with fossil wood. In the centre of the basin as well as towards its southern and western limit, the freestone is replaced by red marls. Beds of gypsum are intercalated at different levels in this immense system, as well as salt, along with calcareous, marly, and magnesian beds. In general the limestone and gypsum are at the base; the freestone conglomerate and marl at the upper part. These deposits appear, both from their stratigraphical position and organic contents, to fill up the interval between the coal formation and the triassic formation. It embraces those groups known in western Europe under the names of *Rothetodte liegende, Kupfer-*

schiefer, *zechstein*, and the *sandstones of the Vosges*. Since this formation is much more developed in Russia than elsewhere, and at the same time, since the beds do not present the same order as in Germany and England, the authors have thought proper to give it the name of the Permean system, upon the same principle that other palæozoic formations have been named from the country where they are most complete and best developed.

Passing to the secondary formations, M. de Verneuil pointed out the difficulties which are experienced in Russia in recognizing the true representative of the triassic formation. Judging from the few fossils which Count Keyserling found on Mount Bogdo, there is reason to believe that that formation exists in the Russian empire; and it is not impossible, that certain red sandstones or marls of the Government of Orenburg and Vologda represent the "*bunter sandstein*."

If the trias has almost disappeared in Russia, the Jurassic formation, on the contrary, is easily recognized by its fossils. It occupies a considerable area, and the authors traced it through the Governments of Trer, Moscow, Valadimir, Simbirsk, Saratof, where it forms a vast basin of which the different parts are for the most part continuous. Another basin extends to the border of the Volga by Kastroma nearly to the eastern limit of the government of Vologda, towards the side of Ust-Sisolsk. Lastly, the same formation constitutes the surface of a great part of the "toundras" or marshy plains of the basin of the Petchora and of the Frozen Ocean. In central Russia the inferior part is composed of pisolite beds which enclose subordinate beds of blue argillaceous limestone. The superior part consists of a quartzose sandstone of considerable thickness and of a bluish grey color, generally non-fossiliferous, in which, nevertheless, some plants and mollusca have, recently, been discovered. It is remarkable that the *Ammonites cordatus* and several other fossils of the age of the Oxford clay are found in the lowest beds; so that the lias and the inferior oolite seem to be absent. A considerable portion, therefore, of the series is absent; this is the more important to be observed since it establishes the deficiency of strata which follow upon the trias, a formation, the existence of which in Russia is still problematical.

The cretaceous formation is found in Russia, only on the south of the Devonian axis which traverses the central part of the Empire. It is one of the most extensive formations of the southern governments, but it does not extend north of the government of Simbirsk. It occupies a considerable zone on the side of the Uralsk, and extends also into the Crimea. M. de Verneuil remarked particularly, that, in this immense country, the cretaceous series is always represented by white limestone with silex, grey limestone, siliceous argil and sandstone, possessing, therefore, all

the characters of the cretaceous formation of the north of Europe. No part of it assumes the type which it possesses in Southern Europe, in Africa, Asia, and which is usually denominated the Mediterranean type.

The nummulite limestone, which in the Crimea reposes on the white chalk with *Belemnites mucronatus*, does not show itself in any other part of Russia.

Passing now to the tertiary formation, M. de Verneuil described the distribution of these different formations in proceeding from the north to the south. The great granitic axis which extends from Volhynia to Donetz appears to be the dividing line between the great eocene and miocene groups. It is, indeed, on the north side of this zone that the eocene deposits are found. The tertiary formation in the Volhynian-Podolian part of the plateaux described by M. Dubois of Montpereux, seems to be the continuation of the miocene deposites of Transylvania and Austria; it assumes, however, rather a different aspect as it advances easterly towards Kischenef, Marioupol and Taganroy. Lastly, a still more extensive and considerable deposit succeeds, viz. that which the authors have called "Aralo-Caspian," since it has been formed under the waters of a sea, the general area of which occupies the present basin of the Caspian and Aral seas. This immense sheet of water, of which these two seas are but the remains, extended even to the western shore of the North sea, and had no communication with the Mediterranean sea or the ocean. In consequence of its being an inland and isolated sea, it was peopled by a peculiar fauna, which reminds us of the present inhabitants of the Caspian sea. How has this great mass of waters in part flowed away so as to leave only the actual seas? Why are these limestones, which were deposited there, and which now form almost all the southern shore of the Black sea, now found at a height from 200 to 300 feet above the level of the existing waters? Anomalies like these can only be explained by supposing that there existed vertical movements of the surface, which disturbed but little the horizontality of the beds. The submersion of a great part of Russia at the termination of the tertiary and diluvial period appears to have been the result of these phenomena.

The communication of the waters of the Mediterranean with the basin occupied at present by the Black sea has had the effect to give to the fauna of this formation in that direction, a character more or less oceanic, but, certainly, very different from that of the Aralo-Caspian district. Indeed we find a very anomalous result; for, though the shores of the Black sea are formed of pliocene deposits, yet amongst the fossil shells of that region, there is not a single species identical with any inhabiting the present Black sea.

After the drainage of the waters from the great Aralo-Caspian basin, the depression which forms the Caspian sea of our day did not immediately take the configuration which we now behold. The water still covered for a long time the Kalmouck steppes to the north, extending even to beyond Simbirsk. These low plains where are found here and there shells which still live in the Caspian sea, resemble completely the bottom of an ocean recently dried up. Pallas knew well the characters of this depression and determined with considerable accuracy its ancient shores, defined on the northwest by the steep elevation of the right branch of the river Volga from Spash to Tzaritzin.

M. de Verneuil now took a rapid survey of the drift formation of Russia, and pointed out the limits of this formation as indicated on the chart. He showed that the extreme points to which the Scandinavian blocks have been transported is about six hundred miles distant from the place where they originated; that their course has been tortuous, conforming to the physical geography of the country and passing principally by the vallies of the Don and Desna, where the detritus extends farthest to the south. He mentioned particularly the fact, that all the erratic blocks of Russia have come from Scandinavia and Finland, diverging as they became scattered over Russia. The Ural, like other mountainous regions of great elevation, has only a local diluvium. The authors have arrived at the conclusion, that, after the Ural and the neighboring country had emerged from the ocean, a considerable part of Scandinavia and Russia in Europe, as well as the north of Germany, was still beneath its waters. M. de Verneuil considers these facts as proof that the glacial theory is not sufficient to account for the principal phenomena of the drift formation of Russia in Europe, inasmuch as the Ural chain, according to that theory, ought to have produced much more considerable glaciers than Finland, and also to have contributed more to the diluvial formation than that region. Moreover, the distance to which these deposits have extended across the country, but little disturbed, and far distant from the high mountains, requires movements of a different nature from that of terrestrial glaciers.

The second part of the work is devoted to the Ural Mountain district, which the authors traversed at eight different points, and of which they have given a special geological chart. This chain, though it attains but 5000 to 6000 feet, forms one of the principal elevated features of the globe, by reason of its continuity and its almost rectilinear direction. From the Straits of Vaigatz to the Orsk it comprehends nearly 18° of latitude, deviating but little from the meridian.

The axis of the chain is ordinarily composed of talcose schist or chlorite and quartzite, which the authors refer to the Silurian

system from the fragments of fossils found there. These are the most ancient rocks of the Ural where there is nothing that is comparable to the gneiss and granite of Scandinavia. The granites of this chain are more recent and have burst through its eastern dislocations, but have not formed its principal summits. It is on the same side that most of the igneous rocks are found, as well as the rich metallic veins which accompany them, together with the alluvial gold. But, though the eastern slope has the greatest attraction for the miner, it is towards the west that it offers to the geologist the most complete and distinct stratigraphical succession. The carboniferous limestone and the associated freestones and schists are easily distinguished from the Devonian and Silurian systems.

The secondary formations do not penetrate into the Ural. Wherever the Jurassic formation approaches this chain, either on the north near the 64° of latitude, or on the south near Tanalyzk and Orenburg, it always preserves its horizontality. There is no doubt that the first elevation of the Ural, and that to which it owes its principal bearing, preceded the Jurassic epoch. Indeed there is reason to believe that it was even anterior to the Permian deposits. The subsequent movements have taken place, without doubt, after the accumulation of the cupreous freestones of the Permian system, and were of sufficient magnitude to modify the position of the axis, and to divide the lines of the previous water-shed; for the beds of copper, whence have been derived the cupreous waters that impregnated the Permian deposits lying to the west of the Ural, are situated on the eastern slope of that range of mountains.

The palæontology of Russia has been treated of as fully as the present state of that department of science will permit. The geological description of each grand system of beds has been accompanied by a general review of the principal fossils found in them; and, at the close of the Permian system, with which the authors consider the grand palæozoic period to terminate, they have endeavored to present a general idea of the whole assemblage of the animal kingdom of that epoch, as well as the different transformations which it underwent up to that time. Lonsdale, to whom the Polypifera were confided, has described the species with great judgment, in the appendix to the first volume.

The second volume is entirely devoted to Palæontology, and contains the description and figures of more than four hundred species. The description of the palæozoic fossils occupies nearly four-fifths of this volume. In order to arrive at conclusions with the greatest possible precision, the authors have availed themselves of all the light which the most competent men have been able to throw on each branch. Reserving that which concerned the pa-

læozoic fossils to themselves, they submitted the examination of the Jurassic and cretaceous to M. d'Orbigny; the comparative anatomy of the fishes to M. Agassiz; those of the plants to MM. Ad. Brongniart and Morris. M. de Verneuil likewise cited as contributor to this work, M. Owen, to whom they were indebted for interesting observations on the structure of the teeth of the genus *Dendrodus*, and on the characters of certain mammifers; Lieut. M. Kokcharof, who accompanied the expedition, and who constructed a table of the minerals of the Ural, inserted at the end of the first volume; and, lastly, M. Viconte d'Archiac, of whose advice they frequently availed themselves in the course of the publication. In conclusion, M. de Verneuil congratulates himself in thus finding an opportunity to express to these gentlemen the obligations of the authors.

Art. XVI.—*On Zoöphytes*, No. IV; by James D. Dana.

Geographical Distribution of Zoophytes.*

Heat, light, pressure, and means of subsistence, influence more or less the distribution of all animals; and to these causes should be added, for water species, the nature or condition of the water, whether fresh or marine, pure or impure, still or agitated. Next to the character of the water, heat is the most prominent limiting agent for marine animals, especially as regards latitudinal extent, while light and hydraulic pressure have much influence in determining their limits in depth.

Although these causes fix bounds to species and families, they do not necessarily confine tribes of species to as small limits. This is sometimes the case, and it is nearly true of a large group of zoophytes; yet other tribes and orders include species whose united range comprises all the zones, from the equator to the polar ices, and every depth, to the lowest which man has explored affording traces of life.

Order Hydroidea.—The Hydroidea are met with in all seas and at great depths, as well as at the surface. The tropics, and the cold waters of the frigid zone, have their peculiar species, and a few are found in fresh waters. The rocks and common marine plants of the sea-coast, the dead or living shell, or the floating Fucus of the ocean, are often covered with these feathery corals; and, about reefs, they occasionally implant themselves upon the dead zoophyte, forming a mossy covering, taking the place of the faded coral blossom.

---

* Report on Zoophytes, p. 101.

The species are most abundant, however, in the waters of the temperate zone, and are common upon some portions of our own coast.

Order Actinoidea.—The Actinoidea are marine zoophytes. All oceans have their species, yet in the torrid zone they more especially abound, and display most variedly their colors and singular forms.

The soft Actinidæ and the Alcyonaria have the widest range, occurring both among the coral reefs of the equatorial regions, and, to the north and south, beyond the temperate zone. The Mediterranean affords species of Gorgonia, Corallium, and Alcyonium, besides numerous Actiniæ. The coasts of Britain have also their Alcyonia and Actinias, and from far in the northern seas, come the Umbellularia, and some other species of the Pennatula family.

Among the coral-making Actinaria, the Madrepore and Astræa tribes are almost exclusively confined to the coral-reef seas,—a region included mostly between the parallels of 28° north and south of the equator,—while the Caryophyllia family are spread as widely as the species of Actinia. Several species of Caryophyllidæ occur in the Mediterranean, and others in the high northern seas, and they are met with at depths of several hundred feet. They are also common among the coral-reefs of the tropics.

The Madreporacea and Astræacea, with the Gemmiporidæ, are the principal constituents of coral reefs. The temperature limiting their geographical range is 66° or 68° F., this being the winter temperature of the ocean on the outskirts of the reef-growing seas. The waters may sometimes sink to 64°, but this appears to be a temperature which they can endure, and not that in which they germinate. The extremes which they will survive prove only their powers of endurance, and do not affect the above statement; for their geographical distribution will be determined by the temperature which limits their powers of germination.

The temperature of the ocean in the warmest parts of the Pacific, varies from 80° to 85°, and here Astræas, Meandrinas, Madrepores, &c., are developed with peculiar luxuriance, along with thousands of other strange and beautiful forms of tropical life. A range from the above temperature to 72°, does not appear to be too great for the most fastidious species. At the Sandwich Islands, which are near the northern limits of the coral seas, Porites and Pocilloporæ prevail, and there are very few species of the genera Astræa, Mussa,* and Meandrina, which are common nearer the equator.

* *Lobophyllia* of Blainville, *Mussa* of Oken.

The range of these reef-forming corals in depth is singularly small. Twenty or perhaps *sixteen* fathoms will include very nearly all the species of the Madrepore and Astræa tribes.* Temperature has little or no influence in occasioning this limit, as 68° F. will not be found under the equator short of a depth of one hundred fathoms. Light and pressure, the latter affecting the amount of air for aëration, are probably the principal causes. The waves, moreover, seldom reaching to a greater depth than thirty fathoms, cannot aid in renewing the expended air below, as they do at the surface.

In recapitulation we state that the Astræacea, Madreporacea, and the Gemmiporidæ among the Caryophyllacea, are, with few exceptions, confined to the coral-reef seas,† and to within twenty fathoms of the surface. The Caryophyllidæ‡ extend from the equator to the frigid zone, and some species occur at a depth of two hundred fathoms or more. The Alcyonaria have an equally wide range with the Caryophyllidæ, and probably reach still farther towards the poles. The Hydroidea range from the equator to the polar regions, but are most abundant in the waters of the temperate zone.

Besides the above-mentioned limiting causes, there are others of importance, one of which may be alluded to in this place; the remaining, belonging more properly to the Geological Report on Coral Reefs and Islands, will be particularly considered in the forthcoming volume by the author. The cause referred to, is that proceeding from original sites or centres of distribution. There is sufficient evidence that such centres of distribution, as regards zoophytes, are to be recognized. The species of corals in the West Indies are, in many respects, peculiar, and not one can with certainty be identified with any of the East Indies. The central parts of the Pacific Ocean appear to be almost as peculiar in the corals they afford. But few from the Feejees have been found to be identical with those of the Indian Ocean. A more complete acquaintance with the corals of these different seas, will, undoubtedly, multiply the number of identical species; but observations, thus far made, seem sufficient to establish as a fact that a large part of zoophytes are confined to a small longitudinal range. This will be seen from the following table, exhibiting, in a general manner, as far as known, their geographical distribution. Each column gives the number *peculiar* to the region specified at top.

---

* The evidences on this point will be presented in the Report on Coral Islands.

† The exceptions belong mostly to the genus Euphyllia, which includes the genus Flabellum, some Turbinaliæ, and the Lobophyllia, having entire lamellæ.

‡ The *Caryophylliæ* of Blainville, with the *Dendrophylliæ*, *Oculinæ*, &c.

	East Indies, Indian Ocean, or Red Sea.	Pacific Ocean.	West Indies.	Pacific and the East Indies, or Indian Ocean.	Extra-tropical.	Doubtful.	Total.
TRIBE ASTRÆACEA.							
Fam. Astræidæ, ...	37	50	29	4	3	16	139
Fungidæ, ...	14	29	6	6	0	10	65
TRIBE CARYOPHYLLACEA.							
Fam. Caryophyllidæ, . . .	13	7	9	2	13	5	49
Gemmiporidæ, . . .	4	5	1?	2	0	2	14
TRIBE MADREPORACEA.							
Fam. Madreporidæ, . . .	30	42	4	8	1?	7	92
Favositidæ,*	14	15	5	3	0	4	41
Poritidæ,†	5	14	6	2	0	1	28
	117	162	60	27	17	45	428

From this table, it appears that only twenty-seven species out of three hundred and six are *known* to be common to the East Indies and Pacific Ocean. With regard to those common to the East and West Indies, for which no column is assigned, there are but two,—the Meandrina labyrinthica and Astrea galaxea,—about which much doubt remains.

We have no authority for accrediting to the West Indies any species of the genera Fungia, Pavonia, Herpetolithus, Merulina, Monticularia, Gemmipora, Anthophyllum,‡ Pocillopora, Sideropora, or Seriatopora, all of which are common in the opposite hemisphere. The Agariciæ, with the exception of two osculant species, are confined to the sub-genus Mycedia, exclusively West Indian, which contains very firm compact corals, often with an Astræa-like character. The Millepores are the only known Favositidæ, and but half a dozen Madrepores have yet been distinguished. The Manicinæ, Caryophylliæ, and Oculinæ, are more numerous in the West Indies than elsewhere, and the Ctenophylliæ (Meandrinæ, with stout entire lamellæ,) have been found only in the West Indies. The genus Porites contains several species, but they are uniformly more fragile and more porous species than those I have seen from the Pacific and Indian Oceans; and the polyps, as figured by Lesueur, are more exsertile, approaching, in this particular, the Gonioporæ.

* The Pocilloporæ, Sideroporæ, Milleporæ, Favosites, and other genera of Madreporacea, in which the cells are internally divided by horizontal septa.

† Part of the Porites of authors, the species having shallow cells closed at bottom, (Porites clavaria and the allied.) The other Porites, with a few exceptions, belong to the genus *Manopora* of the Author, and are true Madrepores in their cells, but with imperfect calicles or none: the *P. spumosa* of Lamarck, and the allied, are here included, besides the *Montipora* of Blainville.

‡ *Sarcinula* in part of Blainville, *Caryophyllia* in part of Lamarck; *Anthophyllum* of Schweigger, who introduces the name, but not of writers on fossil corals.

Art. XVII.—*Review of the New York Geological Reports.*

(Continued from p. 74, this volume.)

Genesee Slate. (Part of F. 8 of Pennsylvania and Virginia. Post-medial Newer Black Slate of Rogers.) Lithologically this upper black slate can hardly be distinguished from the Marcellus shale. It is a true "*mud*" rock, composed of exceedingly fine argillaceous particles charged with bitumen, which imparts to it a deep black color, and indurated so as to possess a slaty structure, yet not sufficiently hard to be useful as a roofing material, for, though when the edges above are exposed, it may resist the elements for a long time, still, when the surface is subjected to atmospheric vicissitudes, it soon splits, crumbles, and decays.

The Genesee slate attains a thickness of from one hundred to two hundred and fifty feet, retaining a remarkable uniformity of appearance and composition throughout its entire mass.

As usual in deposits of this nature, calcareous concretions are common; they are nearly spherical and vary in diameter from a few inches to three feet, and lie in two ranges wide apart. Iron pyrites and calcareous spar are the associated minerals; the latter always in the cavities of the concretions. In sheltered situations this formation produces saline efflorescences. Vanuxem gives the following account of a remarkable liquid discovered in one of the concretions:—"In one of the septaria from the ravine at Ogden's ferry on Cayuga lake, there was a liquid substance of the color of phosphate of iron or Prussian blue, and another substance resembling spermaceti before the oil is fully pressed out. It was composed of small scales, hard and yellowish-white, and was in small irregularly formed masses of the size of a pea, with an appearance of having been melted. The blue liquid was entirely lost; the white substance, though carefully packed in the cavity of the specimen, disappeared, for nothing of it was found when unpacked."

Owing to the destructibility of this slate formation, it occupies a superficial area too limited to be designated on the chart by a particular color. Its place lies at the junction of the purple and brown color, and ranges nearly east and west across the state, from Smyrna, in Chenango county, to Lake Erie. It borders the margins of Cayuga and Seneca lakes, and forms high cliffs in the ravines above the Tully limestone. Its greatest development is in the gorge of the Genesee river at Mount Morris; this locality has given name to the formation.

In the fissures of this slate, near the Tully limestone, Vanuxem mentions the occurrence of a semi-crystalline rock of a blackish-brown color, apparently a mixture of serpentine and limestone, having the appearance of trap rock.

The Genesee slate affords but few fossils, and these are found in its upper portion. The following species, figured in Vanuxem's Report, are tolerably abundant in its eastern extension near Lodi in Seneca county, and Bigstream point, ravine near Ogden's ferry and Cayuga lake.

Vanuxem's Report. (42.)

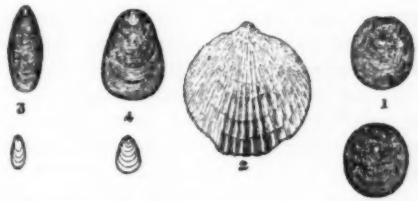


Fig. 1. *Orbicula lodensis.* 2. *O. quadricostata.* 3. *Lingula spatula.* 4. *L. concentrica.*

These occur in the upper twelve or fifteen feet of the mass, and are rare in the western part of the state.

Vanuxem found, also, a long linear smooth leaf of grass or seaweed.

Vanuxem's Report. (94.)

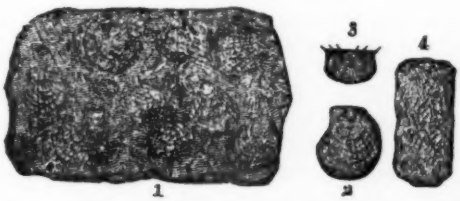


Fig. 1. 2. *Avicula fragilis.* 3. *Strophomena setigera.* 4. *Tentaculites fissurella.*

In the fourth district the Aviculæ of this wood-cut are the most prevalent forms, especially on Lake Erie. It is remarkable that figs. 1, 2, 3, are the same species found in the Marcellus shale; recurring after a long interval in rocks widely separated from each other. The similarity of composition, without doubt, accounts for this analogy in organic remains.

Of the western equivalency of the Genesee slate we have elsewhere spoken.

Portage or Nunda Group. (Part of F. No. 8* of Pennsylvania and Virginia. Post-medidial Flags of Rogers.) In the Annual Reports the strata comprehended in this group were described

* In the New York Reports it is laid down as part of F. 9 of Pennsylvania and Virginia, but we believe this to be incorrect.

under the names of Sherburne flagstones and shale, but from its superior development on the banks of the Genesee river near the town of Portage, (formerly Nunda,) the name was changed to the one at the head of this paragraph. During the progress of the survey a diversity of opinion existed in the minds of the geologists, as to the most appropriate classification and subdivision of the rocks comprised in the upper part of the Erie division of the New York system; viz., of those members lying above the Genesee slate. The difficulties of reconciling the different views arose from the variations and modifications in lithological character, of the equivalent beds at distant localities, together with the scarcity of fossils in most of the rocks. For, though in certain situations, well defined lines of separation can be established, by the difference of mineral composition, yet these geological horizons become more and more obscure as the distance from the starting point increases. The final grouping was established mainly on palæontological evidence.

On the Genesee river the Portage group admits of a threefold subdivision: soft, green, argillaceous shale (Cashaqua shale) beneath, resting on the Genesee slate; green and black shale and sandy shale (Gardeau shale and flagstones) in the middle; thick bedded sandstone (Portage sandstone) above. Shales predominate therefore beneath, sandstones above, with but very few fossils. In going east the arenaceous strata increase in importance, and near Cayuga lake the whole series consists of shale and shaly sandstone passing almost imperceptibly into thick bedded sandstone not very different from those of the Chemung group, so that lithological divisions become unsatisfactory, not only between the subdivisions, but even between the Portage and Chemung groups. Going west the shaly matter augments and the sandstone constantly diminishes, so that along the shore of Lake Erie, there is a thick mass of black shale, succeeded by green and black shales for several hundred feet, with hardly any flagstone or sandstone, and this change is accompanied by an increase of the number of fossils.

"From its general similarity, and from the difficulty also of separating it from the higher rocks on its southern limit, it is colored the same tint on the map, being the northern part of the light umber tint." By consulting the geological map, it will be seen that nearly the whole of that part of the state south of the lakes is occupied by these two formations.

The scenery of that region is remarkable and highly picturesque, as may be gathered from the following extract from Hall's Report:—

"The higher sandstones of the group, and in many instances some of the intermediate ones, produce falls in the streams which pass over them, and some of the most beautiful cascades in the

state are found amongst the rocks of this group. The highest perpendicular fall of water in the state is produced by the rocks of this group, and in none others do we meet with more grand and striking scenery. The pedestrian often finds his course impeded by a gorge several hundred feet in depth; and in the very bottom of this, and scarcely perceptible, is the winding stream, the only representative of the once powerful torrent that has excavated the deep channel. Farther on, above or below, he may see the little stream dashing over a precipice, and almost disappearing in spray before it reaches the bottom; here, however, it gathers itself in a deep pool from which it flows on quietly as before, or gurgling and dashing through the fragments of the fallen cliffs, it finds its way into the gently sloping valley of the softer shales."

The soils overlying the formations up to and as far south as the Tully limestone, are highly calcareous; that derived from the higher rocks, south of that geological zone of the state of New York, is deficient in calcareous matter, as might be anticipated from the absence of limestone beds. It is, therefore, not, on the whole, so fine a wheat growing country as the lower ground further north. However, where the lower argillaceous beds of the Portage group crop out, on the northern slopes of the group, it is stiff and clayey land and nearly as good for wheat as can be found. But as in ascending it becomes more and more siliceous, and the included gravel less rounded by attrition, the wheat crops are less abundant and more uncertain. These soils are better adapted for pasturage, and make good stock farms.

"Almost every ravine and stream," says Hall, "upon the elevation which rises to the south from the Hamilton group, exposes the rocks of the Portage group in greater or less perfection."

The thickness of the various members of this group, taken together, is estimated at 1000 feet.

A great variety of concretionary forms occur throughout the mass. In the black shales they are mostly spherical; in the green or greenish-black they are very flat or lenticular; the latter being less crystalline and more argillaceous than the former. Their regularity and the imitative forms which they occasionally assume are truly astonishing; it is not surprising that the uninitiated should often mistake them for petrified tortoises and turtles. On the Genesee river and Lake Erie a peculiar structure is observable, according to Hall, on the outer surface of some of these concretions, denominated "*cone in cone;*" a similar structure is observable in wedge formed layers in the same formation at the abovementioned localities. From the remarks of this author respecting this appearance in layers of the Portage group, we infer that he supposes it due merely to the powers of segregation. This may be so, but we have been struck with the analogy which

it bears to the figures of the so-called "*Cophinus dubius*" or "wicker basket" fossil, discovered in a vertical position in the Upper Ludlow rocks of England, and figured in Murchison's Silurian Researches.* The English fossil is believed to originate from some organic form, but to what order is not yet decided, as appears from the following extract from that work:—

"*Cophinus dubius.* (Pl. 26, fig. 12.) This is a nondescript fossil, concerning the origin of which no naturalist has yet given a decisive opinion. It has been referred with doubts to the family of soft *Zoophytes*, *Crinoidea*, and to *Mollusca*, so wide from each other are the guesses as to its place in the natural order. All that we can say with certainty is, that it has the shape of an inverted four-sided pyramid, with a column-like rounding off at each corner, and four intercolumniations or sides, transversely situated, producing the appearance of a basket-work; whence, whatever it may prove to be, the fossil is provisionally named, at the suggestion of Mr. König, *Cophinus*, (wicker basket.) This curious body has been adverted to in the text (p. 181) as occurring in positions more or less *vertical* in the uppermost strata of the Ludlow rock, from which I infer that the animal was attached by the end of the inverted cone, while the finely levigated muddy sediment accumulated around the columns or stems."

The chief difference observable between the figures of "cone in cone" and that of *Cophinus dubius*, is that the former is more or less conical, whilst the latter is pyramidal.

The surface of some of the layers of shaly sandstone of the Portage group exhibits an appearance likened to a rivulet of water frozen in the act of descending a declivity, or cooled cinder which has flowed from a furnace in a molten state. This phenomenon is attributed, by Hall, to a semi-fluid mud moving over a slightly descending surface, which has become consolidated.

Casts of mud-furrows and striæ are likewise described as appearing on the under surface of the strata of flagstones.

No minerals of importance have been obtained from this group of rocks in the state of New York. Iron pyrites is disseminated through them, and the concretions yield some crystallized carbonate of lime and sulphate of barytes. Thin coatings of sulphate of lime invest some of the shales; and carbonaceous matter has collected in small quantities so as to produce thin and partial laminæ of coal, but not in sufficient quantity to answer any practical purpose.

Organic remains are, as already remarked, not abundant in the Portage group. The Fucoid figured in Vanuxem's and Hall's Reports, and here given, is the most characteristic. It occurs in

* See wood-cut, page 199, also fig. 12, pl. 26.

the flagstones of the middle part. As these have been extensively used for pavements in the towns and villages of the vicinity, fine specimens are often to be seen on the side-walks of the streets especially in Geneva and Pen-Yan.

Fucoides graphica.

Vanuxem's and Hall's Reports. (104.)

The most common fossil shells in the inferior members of the group are embraced in the wood-cuts on the following two pages. Fig. 1. *Avicula speciosa* is abundant in and characteristic of the Cashaqua shales. Fig. 3. *B. expansus* is thought to resemble an Upper Ludlow fossil figured in Murchison's work, (fig. 32, pl. 5.) The figures are too imperfect to enable one to form an opinion. Fig. 7. *P. acutirostra* is considered by Hall a peculiar form

of this group. Supposing it to be a new species he has given it the name of *Pinnopsis*, from its resemblance to the recent genus *Pinna*. Fig. 8. *P. ornatus* is distinguished from the preceding by the number of ribs. It is a question, however, how far this distinction would hold good if a great number of individuals were compared.

Hall's Report, p. 24. (106.)

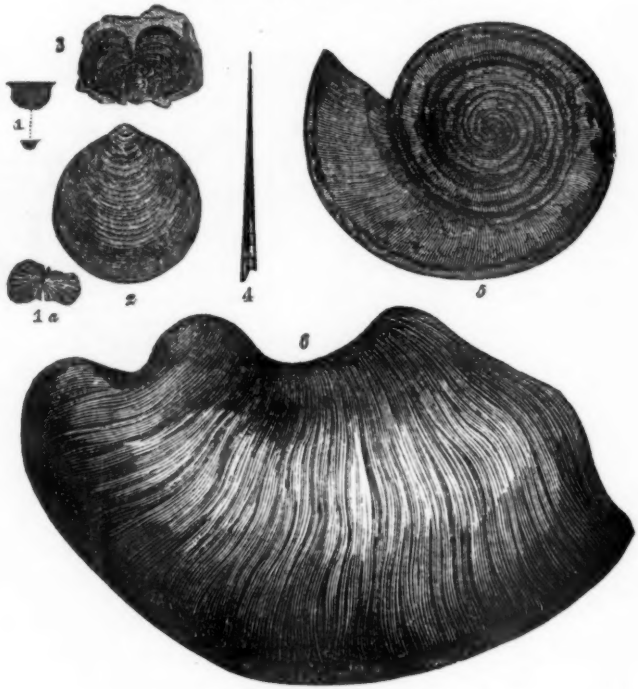


Fig. 1. *Avicula speciosa*. 2. *Ungulina suborbicularis*. 3. *Bellerophon expansus?* 4. *Orthoceras aciculum*. 5. *Clymenia? complanata*. 6. *Goniatites sinuosa*.

The species *Delthyris lævis*, *Cardium? vetustum*, *Orthis tenuistriata*, *Lucina? striata*, *Nucula lineolata*, *Astarte subtextilis*, *Bellerophon striatus*, *Goniatites bicostatus*, *G. sinuosus*, occur in the central and higher part of the group. *D. lævis* is found only in the vicinity of Cayuga and Seneca lakes. It is the only species of the genus *Delthyris* observed in the fourth district destitute of ribs. *C. vetustum* occurs in the soft green shales.

None of the above fossils have come under our observation in the western states. Indeed the shale and sandstone above the western black slate has as yet yielded but very few fossils.

The elegant Crinoidean, *Cyathocrinus ornatus*, figured in Hall's Report, p. 247, has been found in great numbers and in a very perfect state of preservation on the shores of Lake Erie in a stratum about six inches thick, thinning out in every direction within five feet of the centre. Mr. Carley, of Cincinnati, who received a specimen of this fossil, has succeeded, by great perseverance, in developing a most remarkable elongation of the visceral receptacle, several inches in length within the tentaculæ.

Hall's Report, p. 24. (106.)

Fig. 7. *Pinnopsis acutirostra*. 8. *P ornatus*.

So extraordinary was this appendage that when the specimen was shown to Dr. Rœmer, when on a visit to Cincinnati, he could hardly believe that it belonged to the fossil. That it is not extraneous is demonstrated by its structure, its central position between the tentaculæ, and above all by the fact that when the fossil was first received there was no trace of the structure, and that Mr. Carley was induced to search for it by carefully trimming away between the fimbriated fingers of the fossil; because he had observed in the encrinites of his vicinity, curious projections proceeding from the plates surrounding the abdominal cavity.

(To be continued.)

ART. XVIII.—*Caricography;* by Prof. C. DEWEY, M. D.

(Appendix, continued from Vol. ii, Second Series, p. 249.)

No. 206. *Carex cyperoides*, L. Schk. No. 40, Tab. A, fig. 5.

Spica composita terminali capitata; spiculis ovatis, densissimis, *distigmaticis*, supernè pistilliferis, folioso-bracteatis; fructibus ovatis elongato-lanceolatis, subulatis, teretibus, substipitatis, margine scabris, bidentatis, squama lanceolata cuspidata hyalina paulo longioribus.

Culm about a foot high, erect, leafy, triquetrous, smooth, striate, terminated by a head of dense and sessile ovate spikelets; leaves linear, flat and striate, longer than the culm; bracts long and leafy under the spikelets; stigmas two; spikelets staminate below; fruit ovate, long, slender, subtriquetrous, scabrous on the margin, and slightly stipitate; pistillate scale lanceolate, cuspidate, white, a little shorter than the fruit; whole plant pale green.

Found by Drs. Crawe and Wood in Jefferson Co., N. Y., the last summer; common on the continent of Europe, but not found before in our country.

No. 207. *C. æstivalis*, M. A. Curtis. Sill. Amer. Jour., Vol. xlii, p. 28; A. Gray. Kunze's Carices, p. 112, Tab. 28.

Spicis 3–5 longo-cylindraceis, gracilibus, suberectis, laxifloris, suprema androgyna, inferne staminifera, inferioribus exserto-pedunculatis, longo-foliaceo-bracteatis; fructibus *tristigmaticis*, ovatis, tereti-subtriquetris, substipitatis, vix rostratis, ore integris, squama ovata oblonga obtusa submucronata vix duplo longioribus; foliis vaginisque inferioribus subpubescentibus.

Culm 16–24 inches high, erect, triquetrous, slightly scabrous on the edges above, leafy towards the base; leaves long, narrow, flat, striate, shorter than the culm, and with the lower sheaths subpubescent; bracts of the lower spikes long and leafy and surpassing the culm; spikes 3–5, long and slender, cylindric, loose-flowered, suberect, lower ones pedicellate, upper nearly sessile, the highest androgynous and staminate below and with staminiferous scales ovate and acute; stigmas three; fruit ovate, tapering, subtriquetrous, slightly nerved, scarcely rostrate, smooth, at the orifice entire, sometimes slightly recurved at the apex; pistilliferous scale ovate, oblong, obtuse, slightly mucronate, nearly half as long as the fruit, white on the edge and green on the keel; color of the plant light green.

Mountains of North Carolina in tufts; Rev. M. A. Curtis. Named from its flowering long in July and August; A. Gray.

This species much resembles *C. gracillima*, Schw., but obvious characters separate them, as was early remarked by its discoverer, Mr. Curtis, an acute observer and successful botanist. It is a beautiful species.

No. 208. *C. lepidocarpa*, Tausch. Kunze's Carices, p. 52, Tab. 13, fig. 2.

Spica staminifera, erecta, triquetra, cylindracea, cum squamis oblongis obtusis; pistilliferis subbinis, 1–3, *tristigmaticis* rotundo-ovatis, sæpe aggregatis, nunc remotis, densifloris, foliaceo-bracteatis, infima interdum per-remota pedunculata ceterisque sessilibus; fructibus ovatis, triquetris, ellipsoideis, inflatis, nervosis, rostratis, demum recurvo-rostratis, bidentatis, divergentibus, squama ovata obtusa duplo-longioribus.

Culm 8–18 inches high, suberect, slender, triquetrous, slightly scabrous above, leafy towards the base, bracteate; leaves linear, obtusish, striate, shorter than the culm; staminate spike single, erect, cylindric, bearing oblong and obtuse scales; pistillate spikes 1–3, commonly 2–3, often approximate and the two upper nearly sessile, the lowest sometimes remote or very remote and pedicellate and the peduncle nearly inclosed in the sheath; stigmas three; fruit ovate, triquetrous, inflated, nerved, rostrate, the beak being straight or at length recurved, diverging or even turned backwards; pistillate scale ovate, obtusish, half as long as the fruit; whole plant yellowish-green.

Extended widely over New England, New York, Michigan, &c.

This plant, related to *C. flava* and *C. Oederi*, has long been the vexation of botanists in Europe and America. Though it resembles both, and often called a variety of the former, yet it has several times been described as distinct, and the new name is much needed. It is more slender than *C. flava*, and differs in its fruit and scale, and is still further removed from *C. Oederi*. The color is much more yellow than that of *C. flava*.

Note.—*C. Halei*, vol. ii, p. 248, Second Series, is *C. cruscorvi*, Shuttleworth in Kunze's Carices, p. 128, Tab. 32, 1844, and is also *C. sicæformis*, Boott, Boston Jour. Nat. Hist., 1845. I had not received Kunze's work till my paper had gone to press.

C. Steudelii and *C. Boottii* were found the last summer by Dr. Crawe, in Jefferson Co., N. Y.;—both are nearly related to *C. Willdenovia*.

Art. XIX.—*On Coracite, a new Ore of Uranium;* by John L. Le Conte, M. D.

This mineral forms part of a collection made by Mr. B. A. Stanard on the north shore of Lake Superior: the specimen in my possession, is from the surface of the vein, and one portion of it appears to be much weathered; the remainder is quite compact, and apparently unaffected by any exposure; it is, however, traversed in all directions by minute fissures filled with carbonate of lime, sulphuret of iron, and silica. Many of these are almost microscopic, and indeed, quite invisible, until they have been bleached by exposure to a high temperature. For this reason I have been induced to defer any quantitative analysis, until purer specimens shall be obtained. As will be seen, however, by the experiments detailed below, the composition of this mineral is such that it cannot be placed with any known species. On visiting the locality next summer, I hope to obtain specimens that

will admit of a satisfactory quantitative analysis. The following are the characters on which this species is founded.

Massive and compact; cleavage, none.

H = 4·5, G = 4·378. Lustre resinous; fracture conchoidal, uneven: streak gray.

Before the blowpipe unalterable; after exposure to an intense heat, the mass assumes a grayish color; but on examination with a lens, it is found that this appearance is owing to a great number of threads of foreign substances by which the mass is penetrated. With borax it melts slowly into a glass yellow while hot, and pale yellow when cold: in the reducing flame, the bead affords indications of iron.

This mineral as I am informed by Mr Stanard, occurs on the north shore of Lake Superior, about seventy miles from the Sault St. Marie, at the junction of trap and sienite; the vein in which it is found is about two inches in width; but on account of its position, (on the face of an almost perpendicular cliff,) only a few specimens were obtained, and those with great difficulty. For the purpose of ascertaining its composition, the following experiments were made.

A small portion was pulverized: the powder was of a pale gray color.

A. This powder was treated with hydrochloric acid, it dissolved rapidly, with violent effervescence, and slight evolution of hydro-sulphuric acid. The solution was of a bright yellowish green color: it was evaporated to dryness, and left a dark green mass. Water was added and the solution filtered, a small quantity of silica was left on the filter. The solution was then boiled, when the color changed to a dark blackish-green, almost opake; on the ebullition being continued, a copious black-green precipitate was formed, and a colorless solution remained. This precipitate was collected on a filter and washed (*a*).

B. The remaining solution was very astringent; ammonia was added to it with the formation of a copious precipitate, slightly tinged with green, becoming yellow on exposure (*b*). The residual liquid was tested with sulphuric acid, and then with oxalate of ammonia, the latter caused a precipitate of oxalate of lime. The remaining solution, on being evaporated, left a residuum, volatilizable by heat, consisting only of the ammoniacal salts.

a. This precipitate dissolved with ease in dilute sulphuric acid; forming a pale green solution becoming yellow when heated with nitric acid, and on evaporation depositing small yellow crystals, and giving a copious red-brown precipitate with ferrocyanid of potassium. It was therefore protoxyd of uranium.

b. This precipitate was heated with a solution of potassa, a great portion was dissolved leaving a dark brown residuum (*c*). The portion dissolved appeared to be alumnia.

c. The brown substance was dissolved in dilute sulphuric acid, and the solution concentrated by heat; as the ebullition proceeded, a white precipitate was deposited, which was washed with a small quantity of water. When heated before the blowpipe it left a white earth, which gave a colorless assay with borax. The precipitate was therefore sulphate of thoria.

C. The solution left after separating the sulphate of thoria, was evaporated to dryness, and the crucible ignited, the residuum was gray.

d. This powder was boiled with hydrochloric acid almost to dryness; a fine yellow mass was left, which dissolved in water with the exception of a few flocks, (the last portions of the thoria.) The solution gave with ferrocyanuret of potassium a red-brown precipitate, it therefore contained uranium. An excess of solution of carbonate of soda was added to it; the yellow precipitate at first formed, was almost entirely redissolved, a few brown flocculi only remaining, which, when dissolved in hydrochloric acid, gave a deep blue precipitate with ferrocyanuret of potassium. They were sesquioxyd of iron.

The constituents of the mineral thus found, are:

(*a.* and *d.*) Protoxyd of uranium, (the peroxyd in (*d*) being formed by the decomposition of the protochlorid in (A).

b. Alumina.

c. Thoria.

d. Iron.

A. Carbonic acid, silica and sulphur.

B. Lime.

Now the carbonic acid could have been combined only with the lime, and the sulphur with the iron. The silica also was in very small quantity, These were probably the components of the small veins which became apparent on heating the mass. Rejecting these we have left protoxide of uranium, alumina and thoria, as the essential ingredients. The pitchblende from Joachimstahl in Bohemia., was found by Rammelsberg to be a compound denoted by $\dot{U}\,\ddot{\ddot{U}}$. So that this mineral may be regarded as a corresponding compound in which the sesquioxyd of uranium is replaced by alumina.

The physical characters of this mineral approach very closely to those of pitchblende; from which however it may be distinguished by its lustre, and its less specific gravity. The presence of the thoria gives this mineral rather an anomalous composition; but as it is contained in a very small proportion, I apprehend that it will be found adventitious, or that the same vein will eventually furnish specimens of thorite, which being very similar in its physical properties, would not be obvious if mingled with the coracite.

Art. XX.—*Geological Results of the Earth's Contraction in consequence of Cooling;* by James D. Dana.

There are few geological writers at the present day who do not admit the former igneous fluidity of our globe.* In this belief they recognize the fact that the earth has undergone contraction as a consequence of cooling, and acknowledge a readiness to receive as geological truth, whatever may be shown to be the natural effects of such contraction. Yet why, after attributing to this cause, in a general way, much of the unevenness of the earth's surface, should the subject then be dropped, as if no such cause had operated? It is certainly of the highest importance that an agency so universal and so fundamental in its nature, should be followed out in all its bearings to the very limits of its possible effects.

* As matter of history, and on the principle also of "honor to whom honor," we cite here the following passages from the Protogæa of Leibnitz, written in 1691, giving his views respecting the origin of the saltness of the sea, and the formation of mountains and of rock strata.† On the first point he offers the true explanation; and although his views on the other points require some modification, they exhibit the wonderful depth and penetration of his mind. Alluding in the outset to an original state of igneous fluidity, he says (§ iv):—

"Ex hac *genesi rerum* jam observata hactenus procedet *salsi maris origo*. Nam ut perusta, ubi refriguere, humorem attrahunt, unde olea per deliquium Chemicis nascuntur in cella; ita pronum erit credere, sub rerum initiis, nondum separato a luce opaco, *cum globus noster adhuc arderet*, pulsum ab igne humorem abiisse in auras, deinde vero destillationum exemplo renatum, mox remittente æstu in aquosos vapores iterum fuisse densatum, et cùm a congelascente terrestris superficiei massa resorberetur, in aquam denique rediisse, quæ terræ faciem abluens vasta recentis empyreumatis vestigia, salemque fixum in se recepit. Unde natum est *lixivii genus*, quod deinde in mare confluxit."—"Postremò credibile est, contrahentem se refrigeratione crustam, ut in metallis, et aliis, quæ fusione porosiora fiunt, *bullas* reliquisse, ingentes pro rei magnitudine, id est, sub vastis fornicibus *cavitates*, quibus inclusus fuit aër humorve; tum etiam in folia quædam discessisse, et varietate materiæ calorisque *inæqualiter subsedisse massas*, quin et *dissiluisse* passim, fragminibus in *declivia vallium* inclinatis, cùm partes firmiores, et velut columnæ, supremum locum tuerentur: unde jam tum *montes* superfuere. Accessit pondus aquarum, ad alveum sibi parandum in molli adhuc fundo. Denique vel pondere materiæ, vel erumpente spiritu, fracti fornices, maximæque, humore cavitatibus per ruinas expulso, aut sponte montibus effluente, secutæ inundationes, quæ cùm deinde rursus sedimenta per intervalla deponerent, atque his indurescentibus, redeunte mox simili causa, strata subinde diversa alia aliis imponerentur, facies teneri adhuc orbis sæpius novata est. Donec quiescentibus causis atque æquilibratis, *consistentior* emergeret *status rerum*. Unde jam *duplex origo* intelligitur firmorum corporum; una, cùm ab ignis fusione refrigescerent, altera cùm reconcrescerent ex solutione aquarum. Neque igitur putandum est *lapides ex sola esse fusione*. Id enim potissimum de prima tantùm massa ac terræ basi accipio; nec dubito, postea materiam liquidam in superficie telluris procurrentem, quiete mox reddita, ex ramentis subactis ingentem materiæ vim deposuisse, quorum alia varias terræ species formarunt, alia in saxa induruere, e quibus strata diversa sibi super imposita diversas præcipitationum vices atque intervalla testantur." Here we have in general terms the just mean between Wernerism and Huttonism attained long before either Werner or Hutton lived.

Again, he remarks as follows, after some explanations, on the elevation of mountains, § xxii:—"Ego ut facilè admittam, initio cùm liquida esset massa globi terræ,

† An abstract of this passage is given by Lyell in his Principles of Geology, and with illustrative remarks by Conybeare, in the Rep. Brit. Assoc., 1832, p. 366; also a brief abstract of the Protogæa by Prof. E. Mitchell, may be found in this Journal, xx, 56, 1831.

Among English geologists, the subject has received little attention except in the writings of De la Beche; and in the Treatises on Geology in our own language the absolute rising and sinking of the continental lands and the stability of the waters are usually set down as established truths.* In this country, Prof. W. W. Mather† has made the theory of "secular refrigeration" a subject of special consideration: and an account of its supposed bearing on the magnetic variation of our globe and on the tides, has been published by Prof. J. H. Lathrop.‡ In the Geological Society of France, this theory of a cooling globe has been a frequent subject of discussion, owing perhaps, in a great degree, to the attention called to the subject by the elaborate mathematical essay of Cordier.§ M. Elie de Beaumont, the great champion of "soulèvement" theories, appeals to contraction to explain the direction and

---

luctante Spiritu superficiem variè intumuisse, unde illi mox indurescenti primæva inæqualitas; neque etiam diffitear, firmatis licèt rebus, terræ motu aliquando vel ignivomâ eructatione, monticulum factum. Sed ut vastissimæ Alpes ex solida jam terra, eruptione surrexerint, minus consentaneum puto. Scimus tamen et in illis deprehendi reliquias maris. Cùm ergo alterutrum factum oporteat, credibilius multo arbitror, defluxisse aquas spontaneo nisu, quàm ingentem terrarum partem incredibili violentiâ tam altè ascendisse." In § vi, he explains the oscillation of the water and land by supposing the existence of great arched cavities ("fornices," obviously considered as a result of contraction on cooling,) which were afterwards broken. He says: "Ita priore rupto aqua in montes ascenderit, mox, posteriore fracto in abyssum ulteriorem penetrarit, terrestribusque habitatoribus iterum indulserit in sicco locum verisimile est." There is certainly some approach to the views we advocate, in his rejecting the idea of a bodily lifting of mountains by force beneath, and also in the suggestion that oscillations were produced in the water level by subsidences; though we know nothing of his "fornices."

* De la Beche, one of the profoundest geologists of the age, appeals to contraction for the production of fissures, depressions, and elevations by lateral action; he also considers fractures and elevations to form from matter struggling to free itself, from earthquakes of great intensity or from elastic forces acting beneath. Lateral pressure is attributed to contraction, but in the case of the Alps and other cases mentioned, to the extrusion of material from below.

We observe in the memoir by Prof. Sedgwick, on the Cambrian Mountains, (Geol. Trans., ii Ser., iv, 47, 1833,) the following remark: "As the earth has apparently diminished in temperature, we have a right to look for some indication of a contraction in its dimensions. May not some of the great parallel corrugations of the older systems of strata have been produced by such a partial contraction?"

† See this Journal, xlix, 284, 1845. Prof. Mather, in his valuable paper, attributes changes of level to contraction causing depressions and elevations and lateral displacements, to "a subterranean force tending to elevate parts of the earth's surface," to waters gaining access to opened fissures, and to paroxysmal variations in the angular velocity of the earth, the latter causing paroxysmally a westward motion in the internal fluids, and through them, the same motion in certain parts of the crust of the globe, which are consequently dislocated and folded.

‡ This Journal, xxxviii, 68, and xxxix, 90. Prof. Lathrop, (now President Lathrop, of the University of Missouri,) besides recognizing the general effect of contraction in causing a change of water level, endeavors to prove that the fluids of the interior have a slow westward movement, correspondent with the change of magnetic variation, and also a tidal motion, which acting on the crust is a cause of the marine tides.

§ Essai sur la Temperature de la Terre, 4to, pp. 84. Read before the Academy of Sciences, June 4, and July 9 and 23, 1827. Also, the same, translated by the Junior class in Amherst College, 1 vol., 12mo, 94 pp.: Amherst, 1828. See also an abstract in this Journal, xv, 109.

origin of mountain chains, and the same view is adopted by M. Omalius d'Halloy and others, who appear to consider no farther the results that may flow from this cause. MM. Leblanc,* Angelot,† Roys, and Rozet,‡ reason more freely upon the subject, and derive from the theory explanations of volcanic and other phenomena. Prevost§ has the credit of priority in many principles adduced, and of greater precision and comprehensiveness in his deductions. Cordier alluded only in general terms to dislocations from contraction. Prevost shows not only that the cause should produce displacements, but points out ways in which these displacements should take place; and he concludes that the

* Leblanc (Bull. de la Soc. Geol. de France, xii, 137, 1841) endeavors to show by calculation, what are the effects of this contraction in depressing certain parts of the crust and swelling others, the swelling producing, as he argues, void places below and fractures of the crust; he remarks that the largest depressions thus formed are the oceans, while the folds are the mountains, and the plains are the parts "qui correspondent aux exhaussements lents qui ont dû precéder des rides."

† M. Angelot reasoning upon similar grounds, accounts for volcanic action by supposing that the void spaces produced by contraction become filled by water, which water feeds the fires, and may be at times a source of earthquakes and of much metamorphic action, as for instance the production of serpentine. (Bull. Soc. Geol. de France, xi, 178, 245, 1840; xiii, 377, 400, 1842; xiv, 43, Nov. 1842.) The hypothesis of the existence of such void spaces is opposed by M. Roys, and others. (Ibid, xiii, 238, 249.) M. Angelot quotes Bischof's investigations, in Leonhard und Bronn's N. Jahrbuch, 1841, pp. 565, 566, which show that granite *contracts a fourth* of its volume on cooling from a liquid state, trachyte *a fifth*, and basalt *a tenth*, or respectively in decimals, 0·7481, 0·8187, 0·8960. The *lineal* contraction of granite is hence *one-tenth*.

‡ Bull. de la Soc. Geol. de France, xii, 176, xiii, 175, 1841, 1842. Rozet agrees with Cordier with regard to volcanic eruptions; but he attributes some of the great geological changes to a change in the earth's axis of rotation.

§ Prevost's views have been presented in various discussions before the Geological Society of France during the twenty years past, but are most fully detailed in volume xi, of the Bulletin, pages 183 to 203, March, 1840, from which we cited his general deductions in the last volume of this Journal, page 355. The "*Elevation*" theory of craters, which constitutes a part of the views opposed to his theory, is also discussed in the same place, and in the volumes preceding, and following. To give a more just exhibition of his views, and that he may not be charged with any modifications of them, or peculiar deductions, for which the writer alone is responsible, we give here a translation of several paragraphs from his memoir.

"If a cause analogous to that which, according to the theory of *Elevation*, (soulèvement,) is supposed to have raised the Alps or Andes, should elevate the bottom of the South Seas and cause a continent to appear above the waters, what effect would this event have upon the land? It is evident that a quantity of water equal to the volume of the submerged part of the new continent would be thrown over the shores of America, Asia and Europe, and after the oscillations had ceased, parts now dry would remain submerged.

"But passing from these suppositions and reasonings to actual geological facts, do we not observe over all lands, continents as well as islands, ancient marine beaches and thick deposits of marine origin, which have been left dry and still preserve their normal position? The general level of the waters has then been lowered; and in order to this effect, either the waters have diminished, (which few will suppose,) or else in consequence of displacements in the earth's crust, the depressions formed are much more considerable than the elevations.

"If upon all shores, from New Holland to England and Iceland, both of islands and continents, and on the banks of rivers, we recognize undeniable marks of a previous water level at different heights, all nearly parallel, it is very difficult to attribute the successive elevations of such extent, to an absolute elevation of the surface, the different parts of which surface retain the same relative positions as

agency of contraction alone, without the causes of "soulèvement"* usually appealed to, will account for the various changes of level which the continental areas have undergone. He rejects the idea of an *elevating* force which can raise mountains or continents, except such as is incidental to contraction. The principal points in Prevost's theory have already been presented in the preceding volume of this Journal, on page 355; and below we have given in a note a part of his explanations.

The reader will perceive that although the main principles of Prevost are sustained by the writer in this and his former paper, the manner in which these principles are carried out, is in some respects a little different, especially in the idea that the *oceanic areas* have been the more igneous parts of the globe, and for this reason have contracted most;† that certain orographic changes over the continents are due to contraction beneath the oceanic regions, and that the fissurings and mountain elevations have for this reason taken place in some instances near the margin of a continent, or near the limit between the great contracting and the non-contracting (comparatively non-contracting) areas. The efficiency of the cause of contraction has appeared to the writer to be wider and more evident, as the subject has received closer attention; and the study of it has naturally led to modifications of former views.

The theory if true does away with the most incredible of geological dogmas,—the idea of a force acting beneath the continents which can raise them bodily with their load of mountains. The mind unprejudiced naturally asks, where does this force reside? and how does it act? What fills the void left by the raised continent? Why, after an earthquake has passed, should not a mass of rock as large as the Andes and half of South America, sink back again to its place?

---

before the change of level. If, on the other side, we view as submerged all the parts of existing continents and the islands on which marine deposits occur in horizontal position; if we place beneath the water the great part of the points of the surface now existing as mountains, whatever is supposed to have *risen* since the formation of these marine deposits, we cannot but see that there would be no place for vegetation or terrestrial animal life, none for the great lakes with their freshwater animals and plants, and none for the rivers, the remains of whose numerous organic productions are met with in ancient deltas.

"Are we not then forced to admit that while the bottom of the sea has been raised above the level of the sea and made dry land, by a series of displacements, still larger terrestrial areas have disappeared from submergence; and in such a way that the depressions formed were greater than the elevations, a condition without which, I repeat it, the low parts of our existing continents could not have been emerged, a condition requiring for its fulfillment, no aid from the supposed agent of "soulèvement," since this would produce a contrary effect."

* The word "*soulèvement*" in French has a force which does not belong to our English word elevation, as it implies an upheaval from force applied *beneath*.

† Lyell translates and cites the following from Strabo: "We must therefore ascribe the cause [of changes of level] to the ground,—either to *that* ground which is under the sea, or to that which becomes flooded by it, but rather to that which lies beneath the sea, for this is more movable, and on account of its humidity, can be altered with greater celerity." (Principles of Geology, vol. i; Strabo, Geog., lib. 1.)

It is said that waters gain access below, and by a sudden expansion to a state of vapor, the land is thrown up: but, again, why should not the vast weight cause it to sink back as the vapors are condensed? Surely an injection of liquid lavas into any cavities or opened fissures—a material that cools with such extreme slowness—would be a poor support for a chain of mountains. Is the water to gain access through opened fissures? but it would meet molten material rising from below to fill the fissure, and how then could the water thus intercepted make its way, in any large body, *under* the crust, so as to *lift* the surface into mountains? How can such an elevating force get beneath when there is no "beneath" to the fluid column short of the antipodal crust?* The expansive force of contained vaporizable substances pent up in the liquid interior, can be a no more effectual cause; for it does not appear that such a force can act against the incumbent pressure, except by making the lavas somewhat lighter and causing them to swell up into an opening; it can give no eruptive force to the igneous fluid.†

It is urged again that the crust below may possibly be acquiring heat from the internal fires, so as to become elevated by expansion. But there is little to satisfy the mind in this assumed *possibility*, especially when it is considered that through past times the elevation of the land has been on the whole increasing, and yet facts and reason evince that there has also been a gradual cooling below and a thickening of the crust. With such a theory we should have, therefore, the incongruity of an average *increase* of heat through past ages to the present time, and a cooling of the crust going on, that is, a *diminution* of heat, at the same time.

If after all, we can account for facts without calling upon any special force for lifting continents;—if this effect may be a simple result of contraction, we are relieved of many improbable assumptions. We can well conceive that fractures should take

---

* We have not alluded here to the reservoirs of water, which, according to M. Angelot, have been so important a means of elevations and metamorphism, because we see no evidence that such cavities exist. The slow cooling and consolidation within produce a gradual thickening inward of the crust; and no cavities of much size would form till the crust was too thick to yield to the tension by fracturing; and this is a condition which, possibly, is yet hardly attained, for the crust, even if a hundred miles thick, is relatively less than a fourth the thickness of the skin of an orange.

† Speaking of lava in a crater, Prevost says significantly, (loc. cit. p. 188,) "La lave n'est donc pas plus *soulevée* par une force qui serait placée sous l'extrémité inférieure de la coulonne qui s'élève, que la mousse de la bière n'est soulevée par le fond de la bouteille." Again, speaking of volcanic mountains, he says with some humor and with truth, "Il ne faudra pas dire que ces masses sont soulevées, pas plus qu'on ne dit que la *pâte de froment*, qui a été pétrie avec du levain, et qui *lève*, est *sous-levée*." In a note to page 96 of this volume it was incorrectly implied that Prevost attributed all ordinary volcanic eruptions to the collapsing of the earth, consequent on contraction; on the contrary, he recognizes the influence of the process of tumefaction ("boursouflement") in volcanic operations.

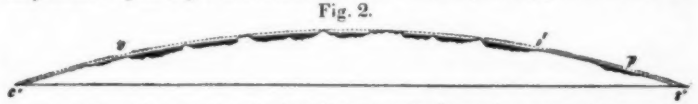
place as a consequence of contraction below a stiffened crust; we know them to be a necessary effect. We see also that depressions would somewhere follow a fracture, and the lateral pressure exerted would be likely to dislocate, often raising and necessarily propping or supporting as it raised. We understand that such fissurings, whether internal or external, would cause shakings of the earth (*earthquakes*) of great violence, and in all periods of the earth's history, and it might be over a hemisphere at once. We comprehend too how the continued contraction of vast areas like the oceans would draw off the waters from the land; and by the several combined effects of the cause under consideration, oscillations in the water level would take place. These effects have been briefly stated in the preceding number of this Journal.* The theory appears to us to be more worthy

* See page 95.—The principles may perhaps be rendered more clear by means of the following figures. In fig. 1, the crust ($c\,t$) is represented covered with wa-

Fig. 1.

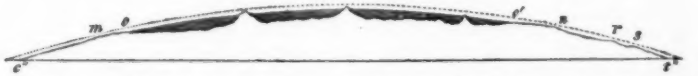
ter ($o\,o'$). In fig. 2, the globe has contracted from the dotted line to $c't'$; $c'o$, $o't'$, are the portions free from volcanic action, (as was the case almost entirely with the parts corresponding to the continents in the Silurian period;) p is an area of wa-

Fig. 2.



ter upon $o't'$. oo' represents the incipient oceanic depression, over which, owing to its igneous character and thinner crust, (this Journal, ii, 352,) contraction went on the most rapidly, and where, at the same time, igneous ejections and displacements (which result from contraction beneath the crust, causing a drawing down of the crust upon a diminishing nucleus) were frequent. It is evident that the depression would at first be too shallow to contain all the water; but as subsidence proceeded, and most rapidly over the oceanic areas, the capacity of the cavity would increase and tend to drain the forming continent. This result might, however, be long delayed by the eruptions and upliftings throughout the area oo', an effect which would diminish the capacity of the oceanic basin, and so compensate for the contraction going on. The land would finally emerge; but the same causes (eruptions and upliftings over the oceanic areas) might make the water rise over it again, and occasion for ages, successive submergings and emergings of the continents. Temporary cessations of subsidence over the oceanic areas might take place from increasing tension preceding a paroxysmal relief by fractures, and this would be another cause of a rise and fall in the water level.

Fig. 3.



As the crust below the oceanic depression becomes thicker by cooling, the contraction, not now causing fractures and upliftings over its own area alone, would produce a tension laterally against the non-contracting area and occasion pressure, fissures, and upheavals; and thus the elevations m, n, r, s, fig. 3, would result. From this figure, the fact will be appreciated that the amount of effect, claimed for

of favor the more closely it is applied, and we would fain believe that the following explanations will be found to secure it some additional attention.

I. *Folding of Strata.*—In our last article on this subject, allusion was made to the foldings of the Appalachian strata, and from the fact that the plications were more abrupt, and the effects of heat more decided, towards the ocean, and also in view of the correspondence observed with analogous facts on the Pacific side of the continent, it was urged that the foldings resulted principally from a subsidence of what is now the oceanic part of the earth's surface. But the peculiar features of the folds present points for consideration which the theory, if true, should explain. We refer again to the admirable paper of the Professors W. B. and H. D. Rogers on the Appalachian chain for the details of the structure there presented.† These geologists have shown that the folds or plications are many and vast. Towards the southeast they are as closely compacted as is in any way possible, so that the annexed figure 4 is given as a just representation of it. To the northeast, the undulations become more and more gentle.

Fig. 4.

Fig. 5.

Cacapon Mountain.

The following outline figure, though having too few folds, (fig. 6,) will present some idea of their extent, and (in connection with figs. 4 and 5,) shows the characteristic forms of the plications, as ascertained by these able geologists.

Fig. 6.

From the Southeast across the Appalachians to the Northwest.

Though the regularity is somewhat exaggerated, the general facts are not so. The surface of the country has since been

---

lateral action is of no improbable magnitude; for the height *n*, though so slight on the scale here given—a diameter of a foot—actually corresponds to a mountain twelve miles in altitude above the sea. It could not well have been made less on the scale adopted. The reader can judge how small an elevation would represent the average height of the continents above the sea; for this height, according to Humboldt, is somewhat less than a thousand feet, or, on the scale in the above figures, about a seventieth part of the elevation *n*.

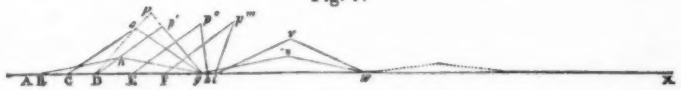
† Trans. American Geol. and Nat., p. 474.—We owe to these geologists, in addition to their exposition of the system of curves in the Appalachian strata, the fine generalization that the *southeasterly* dip in the metamorphic rocks through the regions east of these mountains, has arisen from a close plication of the strata as illustrated in fig. 6. It is apparent from this figure that the strata of both slopes of the fold dip alike to the southeast, as shown also in figure 4.—See this Journal, xliii, 177; xliv, 359; xlv, 341, 346; xlvii, 276.

greatly denuded, and has almost wholly lost the wave-like features, which are so distinct in the stratified beds of rock.

The principal peculiarity of these plications to which we would now ask attention, is the following;—*the greater abruptness of the northwestern slope of each fold, in connection with the diminution of the undulations to the northwestward:* and it will be our endeavor to show that *this peculiarity, and the irregularities which exist, are necessary results of the action of a force laterally exerted.**

This point may hardly require a formal demonstration; yet as other explanations have been offered, we propose to present it in brief detail. In the following figure the folds are represented for convenience of illustration, angular at summit.

Fig. 7.



Let AX represent a bed of stratified clay and sand, in alternating layers, say a thousand feet thick and many miles long; the material either not at all indurated or imperfectly so.

Suppose the *force* to be exerted from the left against A, in a direction varying very little from horizontality.

Resistance to this force will proceed *from gravity*, each vertical square yard pressing with a weight in the case supposed, of *one*

* The Professors Rogers in accounting for the facts they have so skilfully developed, admit a degree of lateral action; but they argue that this action proceeded from the propelling force or thrust of moving waves of molten material beneath the earth's crust, the material of the interior being supposed to be in a state of free liquidity and subject to undulations. With regard to the northwest slopes being steepest, they say (loc. cit., p. 512), "This forward thrust operating upon the flexures formed by the waves, would steepen the advanced side of each wave precisely as the wind, acting on the billows of the ocean, forces forward their crests and imparts a steeper slope to their leeward sides;" and alluding to the position of the operating force, as determined by the greater dislocations to the southeast, they say (p. 517), "the progressive rise of the whole belt towards the side which anciently lay near the shore of the Appalachian ocean, accords entirely with the belief that under the now rent and dislocated margin of the chain there was a vast accumulation of fluid rock charged with compressed gaseous matter, which exerted on the crust an enormous disrupting tension."

Prof. W. W. Mather, in his remarks on the secular refrigeration of the earth, (this Journal, xlix, 284,) accounts for the foldings and for the steeper northwest slopes on the ground of "a paroxysmal elevation and the action of inertia," this paroxysmal elevation, as he urges, arising from a change in the rapidity of the earth's rotation consequent on an abrupt change of dimensions from cooling, (see note, p. 177.) He says, p. 299, "If the earth has at any time become more oblate in consequence of increased angular velocity, inertia would tend to make the solid matter of the exterior of the globe press to the westward." And again, with reference to the steeper northwest slopes, (p. 292,) "Suppose the *sudden* elevation of a mountain mass one mile in height; it would still retain the linear velocity it had when a mile nearer the axis of rotation, while the *proper* linear velocity at this increased distance would be 3·1415÷24 miles, or 694 feet greater per hour than that which it had before its elevation. Inertia therefore would cause the mass at the top to press to the westward with a force proportioned to its mass and the above mentioned velocity."

and a half millions of pounds, or 750 tons;—also *from cohesion* within the bed, and below.

The force will travel slowly from A towards X, on account of the gravity, cohesion and partial compressibility of the mass: the first dislocation will hence take place towards A, and it will therefore produce a bulging, as B *n g*, A at the same time advancing to B. (The distance A *g*, for a specific direction of the force, will depend on the thickness, gravity and cohesion of the bed.)

The force continuing in action, *part* of it will be transmitted towards *g* and X, owing to the difficult flexibility of the bed arising from cohesion and gravity: *another part* will cause B to advance towards C, and tend to raise B *n g* to C *o g*. In the same manner, C *o g* will tend to change to D *p g*.

But the action upon *g* is increasing from two sources, viz:—1. the propagation of the original force through the bed, which is enhanced as the elevation rises;—2. a new force of vast amount proceeding from the gravity of the inclined bed *p g*. Owing to the last mentioned cause, in connection with the yielding nature of the material, *p g* sinks to *p' g*, and D *p' g* becomes the actual position of the bed instead of D *p g*. The sinking of *p g*, and the primal force together, (if the latter were not before sufficient,) would cause *g w* to rise to *h u w*.

The force continuing, the position D *p' g* is changed successively to E *p'' h*, F *p''' i*. The greatest propelling power is exerted by the gravitation of the inclined bed *p g*, when its angle of inclination is between 45 and 60 degrees. Beyond 60° the action is increasingly downward, and the propelling part of the action becomes small. At 90° and beyond, the action is wholly downward, so that in this position, *p g* shortens only from the compressibility of the mass. Now, the action on *g w* is simply the primal force, nearly or quite the whole of which acts upon *g* X. Thus *h u w* rises to *i v w;* and this again, continuing to rise, changes in form in the manner just illustrated.

By this process, therefore, a *series of folds would be produced each with the inclination steepest on the side farthest from* A; *and moreover, these folds would be necessarily most abrupt the nearer they are to* A.

In the above, the lateral force has been supposed to act directly upon the borders of an oceanic depression. When the contraction in progress produces *fractures over the interior of a continent*, the continued contraction and increasing lateral pressure, still operating upon the same yielding area, might *produce plications parallel with the line of fracture, which would be most abrupt near it, and diminish in the distance*, a fact illustrated in the Urals.* The plications would differ in extent on the two sides of the line, provided the force or the material were different.

* Geology of Russia and the Urals, R. I. Murchison, i, 462.

II. *Reasons why this action should not produce perfectly regular and uniform folds.*—Irregularities would proceed—

1. *From a variation in the thickness of the bed*, in consequence of which there would be a difference in the gravity of the mass in different parts.

2. *From a want of uniformity in the material* or its state of induration, causing the cohesion to vary, and hence also the flexibility or frangibility of the bed.

3. *From an inequality in the action of the force upon the different parts of the line against which it operates.* If the main cause of this force is contraction beneath the oceanic parts of the earth, such inequalities must have existed. For we know that igneous vents have been localized to a great extent over these oceanic areas, and generally they occur in lines, as groups of islands evince. Consequently the effects of contraction could not be equal along a given line.

4. From any irregularity which there might be in the contraction going on (for there should be some such contraction) beneath the area which is subjected to the lateral pressure.

A *fifth* reason might be added, but it is of a general nature and will form the subject of another communication. The four specified are sufficient to set aside any objections to the view urged on the score of the irregularities which exist.

III. *Effects of gravity on the inclined strata.*—When the beds become very much inclined, or dip at a large angle, the more sandy layers if not too much indurated, would settle bodily downward; the clayey layers would also settle, but owing to their cohesion when moist, they would become flexed or crimpled. *Thus plications would be produced*, from gravity alone; a fact abundantly illustrated in the metamorphic rocks of New England and other countries; and it might happen that small plications should in the same manner be produced between non-plicated beds.

IV. *Effect of lateral action where there is no plication, or but a limited amount of it.*—If the material subjected to lateral pressure be not capable of folding, or *only partially so*, the region operated upon instead of rising into a series of elevations, would be raised into one or more ridges of much greater height. Has not this last been the case on the Pacific side of the continent? or, is the elevation owing to a less nearly horizontal direction of the lateral force? or to a greater amount of oceanic depression?

V. *Intruded igneous rocks occurring with plicated beds.*—The occurrence of dikes or intruded masses of igneous rock in a plicated region, is no certain evidence that the intrusion was the cause of the plication, as the two effects, on the principles explained, might be concomitant results of the same general operation.

VI. *The folding of strata by subsidence of the plicated region can be only of small extent.*—This subsidence may or may not be attended by a *general contraction* of the earth's crust below the plicated bed. If not, then the bed, before straight, must be lengthened by the action to fit the curve of depression: a curve of a semicircle would require an extension of one half, in the bed, and a more abrupt plication, a greater extension. It is well known that clays and sand layers would not bear such a stretching, and the result could be accomplished only by fractures and openings. The material moreover would be drawn off from the summits of the convexities, or very much thinned out in those parts; a supposition not warranted by facts to the extent required in the explanation. The hypothesis moreover would not account for the greater steepness of the northwest slope.

But if the material beneath may be supposed to have contracted correspondingly with the amount of plication, then folds might have been produced by the process. The hypothesis however has many weighty objections. It is at variance with the fact that this same region remained unplicated, at least in the parts occupied by the coal formation, till after the coal epoch, although the contraction must have been more rapid during the preceding epochs of the earth's cooling.* The non-plication of the Silurian rocks of the centre of our country, adds force to this objection. Why this long delay in the action of those violent forces supposed to be imprisoned beneath the earth's crust?

Farther, a stiffened crust cannot be much folded by mere *shrinkage*, where the material is like that of the earth's crust. The fact that the Silurian rocks of the interior are not plicated by contraction below them, is evidence of this. Instead of becoming plicated, they have probably aided by lateral action in producing the elevations on the east or west, or the Ozark Mountains or other heights intermediate.

Moreover, the very *close compacted* folding illustrated in figs. 4 and 6, a result which only lateral pressure could effect.

VII. *Position of volcanoes.*—The occurrence of volcanoes mostly in the neighborhood of the sea, is a necessary result of these principles. For we have already stated that fractures of the earth would be likely to take place near the limits between the contracting and non-contracting areas:† *here* they would have that depth and extent which is necessary in order that they should remain open as the seat of perpetual eruptions; for there is necessarily a wide difference as regards extent between those fissures

* The writer has offered as an explanation of this non-plication till after the coal epoch, the suggestion that the crust over the oceanic (or igneous) portions, had so far cooled by that time, that the pressure or strain arising from contraction was no longer relieved to the same extent as before by rents and upliftings over the igneous region. This lateral action was exerted long previously, but its greatest effects on the earth's features date subsequently to the carboniferous epoch.

† This volume, page 96.

that only allow the material to escape and form dikes, and those great fractures from which an Etna, or a range of Chimborazos, has originated. We have remarked in another place,* and the fact is sufficiently important to be again repeated, that the absence of the sea is no reason for the absence of volcanoes from the interior of our continents; since this same freedom from volcanoes existed in the Silurian epoch, when these very continents were mostly under salt-water.

VIII. *Geological epochs.*—This subject suggests a cause for the transitions marking geological epochs. The formation of the Appalachians was attended by rendings and emissions of heat on a vast scale, and the baking and crystallizing of the metamorphic rocks of the region, as well as the debituminizing of the mineral coal rendering it anthracite, are attributed by the Professors Rogers to this action. It is not a matter of surprise that there should have been an abrupt cessation with this event, of preëxisting forms of marine life. The period when the effects of dislocation began to be transferred from the oceanic areas to the continents, appears to have been the era of this catastrophe; and it was an era of similar changes in various parts of the globe. The previous epoch no doubt had its violent convulsions, but still there was *comparative* quiet favoring the continuance of Silurian life.

This era was probably followed after a while by another of similar quiet to that which preceded it, along the eastern portions of our country; and during this elapsing time, tension (from the progressive contraction,) may have been slowly increasing. The opening of the trap fissures, and their injection with the molten rock, may mark the termination of this period of quiet—the extensive fractures being a result of the increased tension. The parallelism of the dikes to the Appalachians, alike in Nova Scotia, the Connecticut valley, and New Jersey, and farther south, renders it probable that the same grand cause which produced the elevation of those mountains, produced also this result. These igneous eruptions and the vibrations which the ocean must at times have experienced, are adequate to explain the occurrence of a second era in the geological history of this country.

We know not how widely the last catastrophe extended over the globe, or whether it belonged to this continent alone, for we may not say with certainty whether displacements and fissure-ejections of the same general era in Europe, belonged to this particular period in the era. The above facts are brought forward to illustrate the general principle, already admitted by some writers, that such grand crises,—by causing wide emissions of heat, a change of level in the sea, and violent shakings of the globe with its mobile waters,—were in early times a necessary result of the

* This Journal, ii Ser., ii, 353.

contraction in progress. Facts on record prove farther, that these grand catastrophes had their widest influence after the coal era, and became less and less general as succeeding ages rolled on.

IX. These principles give us some *data for comparing the energy of forces in past times in the earth's history, with those now in action.*—In admitting them as a basis of geological reasoning, we may be considered as proceeding on an hypothetical basis. Yet in reasoning without reference to them, is the ground assumed any the less hypothetical? With those who believe in the former igneous fluidity of our globe, contraction is the grand and fundamental agency to be first considered after the general principles of solidification.

X. *Tides and paroxysmal movements beneath the crust of the globe.*—In the course of this article we have not alluded to the effects of tidal and other motions in the heated interior of the globe, leaving it for those who can prove their occurrence to modify thereby the explanations here offered. Several difficulties have appeared to the writer to strengthen the opinion advocated by Lyell and Poisson, that the globe, before its crust had consolidated, had become so stiffly viscid as not to admit of tides, a condition believed to be essential to the formation of a permanent crust. If there were *daily tides*, or a *westerly movement*, or if *undulations* were possible, sufficient to throw up the Appalachians, why, as we have asked before, were these mighty and resistless agents nearly dormant in this part of the globe till after the coal era? Why did they not act violently upon the Silurian rocks of the west, before the period that originated the Appalachians? and why not also more decidedly at the time of this great catastrophe? These questions are, perhaps, in part answered by Prof. Mather, by the argument that there would be grand paroxysmal effects attending contraction, causing at long intervals, a violent westerly movement beneath the crust. But, again, why if the cause of the mountain elevations is a westerly movement (that is a movement from the *east*) beneath the crust, why should we have mountains on the *west* side of the continent, while the wide interior is nearly flat? And why should these western mountains have attained such an altitude? Why should the areas of greatest igneous action be to the west of the summit on the Rocky Mountains, and to the east over the Appalachian region; that is, on the *oceanic* side in each case? These are among the objections to the hypothesis, that internal tides or undulations have been a prominent agent in geological dynamics since the beginning of the Silurian epoch; and if the explanations of phenomena, offered in this article, are at all satisfactory, they contain a still weightier argument against the view.

ART. XXI.—*Notes on the Herbaria, Gardens and Botanists of Upsal, St. Petersburg, &c.*, gathered from the letters of a distinguished botanist during a continental tour.*

AT Upsal, I was fortunate enough to find both Prof. Wahlenberg, who has the care of the Museum of Natural History and Botanic Garden, and Professor Fries, at home. Both received me with every civility and attention, and I spent as much time with one or the other as my short stay would admit of my devoting to botany. The Museum was founded after the younger Linnæus's death, when the loss to the country of Linnæus's herbarium, made the government feel the want of a public establishment for the reception of national collections. The herbarium, placed in two spacious and well lighted rooms, consists chiefly of Thunberg's herbarium, Afzelius' African herbarium, and Wahlenberg's private herbarium. Of these, Thunberg's is by far the most valuable; it is glued down on white paper, after the model of our English collections, but on smaller paper than the Banksian, the species, in like manner, gathered in generic covers: the genera have been arranged by Wahlenberg, according to Sprengel. Besides the plants collected by Thunberg himself at the Cape, Japan, Ceylon, and in North Europe, it contains a considerable number of authentic specimens from Swartz, Lamarck, and other botanists of his day. * * * * * I soon found that the ascertaining of the identity of the specimens described in his *Flora Capensis*, would be a work of much more labor and time than I could bestow. His plants are indeed all named; but in many cases he had discovered the mistakes he had made, erased his original names so as to render them quite illegible, and substituted others; so that unless some botanist of correct judgment, and well acquainted with Cape plants, were to come and bestow some months on going through his herbarium, the puzzles of the *Flora Capensis* must remain uncleared. The specimens are generally small, but with a few exceptions tolerably satisfactory and well preserved. Afzelius's Sierra Leone collection is a very fine one;

---

* Extracted from the London Journal of Botany for October, 1846.

We are informed by the writer of these notes, that Dr. Lehman at Hamburg, has found time to finish the *Plantæ Preissianæ*: at Copenhagen, Prof. Schouw, so well known for his labors on geographical botany, has been ill for the last year and a half. Dr. Liebmann, the adjunct professor, has lately returned from Mexico, with a collection of plants which he estimates at 10,000 species. The herbarium and copious manuscripts of Vahl are still in the possession of his son, Dr. Vahl, (who lived many years in Greenland,) the present librarian at the Botanic Garden. At Gottenburg, Areschoug, who lectures at the High School, is a zealous investigator of *Algæ*.

At Stockholm the writer met Prof. Wikström, and examined the herbarium of Swartz, which belongs to the Academy of Sciences. It appears to be extensive and in good preservation.

one set is glued down, after the pattern of Thunberg's, and the remainder, often many duplicates, are loose in sheets of a larger size. The specimens are generally good, and many of them accompanied by fruits in a separate collection, but with references to the specimens.

The living collection in the Botanical Garden, though not kept in such good order as could be wished, is tolerably rich. The Russian species, received through the Petersburg garden, flourish well here; other exotics are such as could be obtained through Booth, of Flottbeck, and some interesting plants are the descendants of those cultivated by Linnæus, and thus constitute the only authentic specimens of such as he did not dry for his herbarium. We went with Prof. Fries to see the house in which Linnæus lived, and the garden where he cultivated his 'Hort. Upsal.' plants, now no longer belonging to the family, but in which the buildings used by this great father of modern botany as green-houses and lecture-room, still exist; and a poplar tree, known to have been planted by his own hands, is shown with great reverence. Proud though we may be in England of possessing his collections, it is impossible to be at Upsala, where so much is associated with his name, to see the respect paid to his memory, and the value attached to the few manuscripts or other remembrances of him which they have been able to amass, without feeling that this is the place where his library and herbarium ought to be, and that if they had been here the botanical world would long since have known what information can or cannot be derived from the specimens preserved; and as a tribute to his extraordinary genius, such of his manuscripts as are really interesting or curious, (and they are not a few,) would have been given to the public, instead of lying unknown in the attics of our Linnæan Society.

Prof. Fries is devoting himself, with his usual zeal, to the investigation of the Scandinavian Flora, (that of the Scandinavian Peninsula from Petersburg to the North sea,) and has been specially studying *Hieracium*, *Salix*, and *Carex*. The general result of his observations has lately appeared under the title of "*Summa Plantarum Scandinaviæ*," being an enumeration of the flora of the country, with geographical indications of each species, and detailed characters for such as are not in Koch's Synopsis, or are differently characterized by Fries. It appears to be a useful work, more especially as a kind of resumé of the conclusions drawn by Fries from a long and careful study of many difficult species.—(pp. 528–530.)

St. Petersburg contains two great botanical collections, that of the Academy of Sciences, and that of the Botanical Garden. The herbarium of the Academy of Sciences is under the direc-

tion of Dr. Carl Anton Meyer, and under him, Dr. Ruprecht, but without at present any assistance for the mechanical part of the business. It is contained in two large rooms and a small one, around which are arranged the cabinets with mahogany glazed doors—useful in enabling you to see where the genera are, without opening the doors; but a luxury, the cost of which might have been better applied in the purchase of specimens, for which the Academy is very short of funds. The specimens are loose, in double sheets of paper of a large size, and arranged in natural orders, the genera separated by thin sheets of pasteboard, the species under each genus being placed alphabetically; the whole loose on the shelves, not tied in bundles, a great advantage over the usual continental custom of having from one to a dozzen strings to untie every time you would look at a specimen; but still, if the herbarium were to be frequently consulted, having the disadvantage of not preserving the specimens so well as we do by glueing them down. The collection is rich in Russian and in Brazilian plants, it contains all Chamisso's and a very complete set of Sieber's plants, and besides some of the usual Cape collections, a very good one made by Hesse, with a miscellaneous collection from other parts of the world, the whole in very good consulting order, the undetermined and doubtful plants being at the end of each natural order. Besides this general herbarium, there is Marschall von Bieberstein's Tauro-Caucasian herbarium, nearly complete with good specimens, and Trinius's *Gramineæ*, a most extensive series, remarkably rich in authentic specimens. Dr. Meyer, who lives at the Botanic Garden, and is intimate with Dr. Fischer, has not published any thing since the Monograph of *Ephedra*, which appeared two or three months ago; he is now investigating the Roses allied to *R. cinnamomea*. Dr. Ruprecht has been at work on the Flora of Russia, and has completed the three last parts of the "*Contributions to the Flora of Russia*," containing a critical enumeration of the plants of the Samoied territory, with several new species, some of them figured; of the Russian *Ferns*, of which some are new; and of the plants of the neighborhood of St. Petersburg, with geographical and historical notes to each. His worldly position at the Academy is not satisfactory for a man of so much ability, and he appears anxious to go out on an expedition round the world. The herbarium of the Botanic Garden, under the general direction of Dr. Fischer and his assistants, Dr. Meyer and Avé-Lallemant, is under the especial care of Mr. Meinshausen, a young man who accompanied Schrenk into Soongaria; there appeared to be also one or two young men at work as assistants. The space allotted to it is small; the different collections it consists of are, as yet, separate, and all tied up in bundles, so that it is difficult to judge of its extent; but it must be considerable. It contains the herbarium of the late

Dr. Mertens, of Bremen, left by him in very good order, containing about twenty-five thousand species, and especially rich in European plants; that of Schrader, of Göttingen, bulky, but of less value; that of Schumacher, of Copenhagen, containing, like other Danish herbaria, a great many of Rohr's Cayenne plants, Thonning's African ones, &c.; very rich sets of Turczaninow's, Sowitz's, and Schrenk's plants, and those of other Russian collectors, besides miscellaneous collections. The library is also very good. What both herbaria are chiefly deficient in, appear to be East Indian, South American, (except Brazil and Guiana,) and Antarctic plants. Dr. Fischer himself has been at work at *Astragali*, and has prepared for the press a detailed monograph of the section of the *Tragacantheæ;* and with Dr. Meyer, he is now publishing the first part of a folio work, under the title of "Jardin de Saint Pétersbourg," to contain colored drawings and descriptions of interesting plants which have flowered here. This first part has a short account and drawing of the new Palm house, in the state it had attained last season, and figures and descriptions of ten species, amongst which is a very handsome Brazilian *Almeidea*. Dr. Fischer possesses a private herbarium, arranged in large double sheets like that of the Academy of Sciences, and apparently containing a very considerable miscellaneous collection in good order. I met here Prof. Trautvetter, of Kieff, who is at work on the plants brought by Middendorf from Northern and Arctic Russia; and as there are but few aids at Kieff, he came here to consult books and herbaria. The Flora gathered by Middendorf, is, in many respects, that of Melville Island, but more numerous in species.—(pp. 531–533.)

ART. XXII.—*Observations on the Rocky Mountains and Oregon;* from the Reports of the Exploring Expeditions of Capt. J. C. FRÉMONT.*

FEW travellers have encountered greater hardships, and none have exhibited more indomitable courage, or untiring zeal, than Captain Frémont in his explorations about the Rocky Mountains, and among the heights, lakes and deserts of Oregon and California. The *first* of the two Expeditions of which we have an account in the volume above referred to, terminated at the summit of the Rocky Mountains, after an examination of the south pass

* Report of the Exploring Expedition to the Rocky Mountains in the year 1842, and to Oregon and North California in the years 1843, '44, by Brevet Captain J. C. Frémont, of the Topographical Engineers, under the orders of Col. J. J. Abert, Chief of the Topographical Bureau. 694 pp. 8vo, with plates and a map. Washington, 1845.

—the lowest depression of the mountains and the present route to Oregon—and an ascent to the summit of Frémont's peak in the Wind river chain, believed to be the highest elevation in the Rocky Mountain range. In the *second*, by a different route, he reached the same pass, and thence proceeded to the Great Salt lake and Fort Vancouver; he next went south just to the east of the Cascade range, over an unexplored region, to latitude 38° 44′, where he crossed the snowy heights, and finally after severe trials, arrived at San Francisco. From this place he went south, ascending the fine valley of the Joachim, and in latitude 34½° turned northeast across the California semi-desert, to Utah lake. A complete circuit was thus made in eight months, which cost them 3500 miles of travelling; and during this time they were never out of sight of snow.

Captain Frémont's Journal is written in a graphic style, bearing evidence of literal accuracy in all its statements, and yet in many parts reading like a romance. With deep interest we follow the adventurous traveller threading his pathless way over lofty ridges, through dense forests, and up the icy heights, till at last he stands perched on a pinnacle of the Wind river mountains. Our readers may have often perused the account, yet will find renewed interest in the following description of the last day of this perilous adventure.

"When we had secured strength for the day by a hearty breakfast, we covered what remained, which was enough for one meal, with rocks, in order that it might be safe from any marauding bird; and, saddling our mules, turned our faces once more towards the peaks. This time we determined to proceed quietly and cautiously, deliberately resolved to accomplish our object if it were within the compass of human means. We were of opinion that a long defile which lay to the left of yesterday's route would lead us to the foot of the main peak. Our mules had been refreshed by the fine grass in the little ravine at the Island camp, and we intended to ride up the defile as far as possible, in order to husband our strength for the main ascent. Though this was a fine passage, still it was a defile of the most rugged mountains known, and we had many a rough and steep slippery place to cross before reaching the end. In this place the sun rarely shone; snow lay along the border of the small stream which flowed through it, and occasional icy passages made the footing of the mules very insecure, and the rocks and ground were moist with the trickling waters in this spring of mighty rivers. We soon had the satisfaction to find ourselves riding along the huge wall which forms the central summits of the chain. There at last it rose by our sides, a nearly perpendicular wall of granite, terminating 2,000 to 3,000 feet above our heads in a serrated line of broken, jagged cones. We rode on until we came almost immediately below the main peak, which I denominated the Snow peak, as it exhibited more snow to the eye than any of the neighboring summits. Here were three small lakes of a green color, each perhaps a thousand yards in diameter, and apparently very deep. These lay in a kind of

chasm; and, according to the barometer, we had attained but a few hundred feet above the Island lake. The barometer here stood at 20·450, attached thermometer 70°.

"We managed to get our mules up to a little bench about a hundred feet above the lakes, where there was a patch of good grass, and turned them loose to graze. During our rough ride to this place, they had exhibited wonderful surefootedness. Parts of the defile were filled with angular, sharp fragments of rock, three or four and eight or ten feet cube; and among these they had worked their way, leaping from one narrow point to another, rarely making a false step, and giving us no occasion to dismount. Having divested ourselves of every unnecessary encumbrance, we commenced the ascent. This time, like experienced travellers, we did not press ourselves, but climbed leisurely, sitting down so soon as we found breath beginning to fail. At intervals we reached places where a number of springs gushed from the rocks, and about 1,800 feet above the lakes came the snow line. From this point our progress was uninterrupted climbing. Hitherto I had worn a pair of thick moccasins, with soles of *parfléche;* but here I put on a light thin pair, which I had brought for the purpose, as now the use of our toes became necessary to a further advance. I availed myself of a sort of comb of the mountain, which stood against the wall like a buttress, and which the wind and the solar radiation, joined to the steepness of the smooth rock, had kept almost entirely free from snow. Up this I made my way rapidly. Our cautious method of advancing in the outset had spared my strength; and, with the exception of a slight disposition to headache, I felt no remains of yesterday's illness. In a few minutes we reached a point where the buttress was overhanging, and there was no other way of surmounting the difficulty than by passing around one side of it, which was the face of a vertical precipice of several hundred feet.

"Putting hands and feet in the crevices between the blocks, I succeeded in getting over it, and, when I reached the top, found my companions in a small valley below. Descending to them, we continued climbing, and in a short time reached the crest. I sprang upon the summit, and another step would have precipitated me into an immense snow field five hundred feet below. To the edge of this field was a sheer icy precipice; and then, with a gradual fall, the field sloped off for about a mile, until it struck the foot of another lower ridge. I stood on a narrow crest, about three feet in width, with an inclination of about 20°, N. 51° E. As soon as I had gratified the first feelings of curiosity, I descended, and each man ascended in his turn; for I would only allow one at a time to mount the unstable and precarious slab, which it seemed a breath would hurl into the abyss below. We mounted the barometer in the snow of the summit, and, fixing a ramrod in a crevice, unfurled the national flag to wave in the breeze where never flag waved before. During our morning's ascent, we had met no sign of animal life, except the small sparrow-like bird already mentioned. A stillness the most profound and a terrible solitude forced themselves constantly on the mind as the great features of the place. Here, on the summit, where the stillness was absolute, unbroken by any sound, and the solitude complete, we thought ourselves beyond the region of

animated life; but while we were sitting on the rock, a solitary bee (*bromus, the humble bee*) came winging his flight from the eastern valley, and lit on the knee of one of the men.

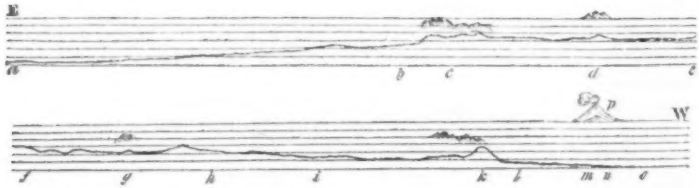
"It was a strange place, the icy rock and the highest peak of the Rocky Mountains, for a lover of warm sunshine and flowers; and we pleased ourselves with the idea that he was the first of his species to cross the mountain barrier—a solitary pioneer to foretell the advance of civilization. I believe that a moment's thought would have made us let him continue his way unharmed; but we carried out the law of this country, where all animated nature seems at war; and, seizing him immediately, put him in at least a fit place—in the leaves of a large book, among the flowers we had collected on our way. The barometer stood at 18·293, the attached thermometer at 44°; giving for the elevation of this summit 13,570 feet above the Gulf of Mexico, which may be called the highest flight of the bee. It is certainly the highest known flight of that insect. From the description given by Mackenzie of the mountains where he crossed them, with that of a French officer still farther to the north, and Colonel Long's measurements to the south, joined to the opinion of the oldest traders of the country, it is presumed that this is the highest peak of the Rocky Mountains. The day was sunny and bright, but a slight shining mist hung over the lower plains, which interfered with our view of the surrounding country. On one side we overlooked innumerable lakes and streams, the source of the Colorado of the Gulf of California; and on the other was the Wind river valley, where were the heads of the Yellowstone branch of the Missouri; far to the north, we could just discover the snowy heads of the *Trois Tetons*, where were the sources of the Missouri and Columbia rivers; and at the southern extremity of the ridge, the peaks were plainly visible among which were some of the springs of the Nebraska or Platte river. Around us, the whole scene had one prevailing feature, which was that of terrible convulsion. Parallel to its length, the ridge was split into chasms and fissures; between which rose the thin lofty walls, terminated with slender minarets and columns, which is correctly represented in the view from the camp on Island lake. According to the barometer, the little crest of the wall on which we stood was three thousand five hundred and seventy feet above that place, and two thousand seven hundred and eighty above the little lakes at the bottom, immediately at our feet. Our camp at the Two Hills (an astronomical station) bore south 3° east, which, with a bearing afterward obtained from a fixed position, enabled us to locate the peak. The bearing of the *Trois Tetons* was north 50° west, and the direction of the central ridge of the Wind river mountains south 39° east. The summit rock was gneiss, succeeded by syenitic gneiss. Syenite and feldspar succeeded in our descent to the snow line, where we found a feldspathic granite. I had remarked that the noise produced by the explosion of our pistols had the usual degree of loudness, but was not in the least prolonged, expiring almost instantaneously. Having now made what observations our means afforded, we proceeded to descend. We had accomplished an object of laudable ambition, and beyond the strict order of our instructions. We had climbed the loftiest peak of the Rocky Mountains, and looked down upon the snow a thousand feet

below, and, standing where never human foot had stood before, felt the exultation of first explorers. It was about two o'clock when we left the summit; and when we reached the bottom, the sun had already sunk behind the wall, and the day was drawing to a close. It would have been pleasant to have lingered here and on the summit longer; but we hurried away as rapidly as the ground would permit, for it was an object to regain our party as soon as possible, not knowing what accident the next hour might bring forth.

"We reached our deposite of provisions at nightfall. Here was not the inn which awaits the tired traveller on his return from Mont Blanc, or the orange groves of South America, with their refreshing juices and soft fragrant air; but we found our little *cache* of dried meat and coffee undisturbed. Though the moon was bright, the road was full of precipices, and the fatigue of the day had been great. We therefore abandoned the idea of rejoining our friends, and lay down on the rock, and, in spite of the cold, slept soundly."—pp. 68, 69, 70 and 71.

Other pages of general interest might be cited, but we pass to some points of geological importance, in the regions examined.

It was before known that the slopes of the Rocky Mountains were very gradual in inclination; but the fact is brought out with greater definiteness and more distinctly to the eye, in the section presented by Lieut. Frémont, of which the following is a reduced copy.



Profile of the route from the mouth of the Kansas to the Pacific, by J. C. Frémont, in 1843. Vertical scale to horizontal as 1 to 30. The intervals between the horizontal lines are each 2,000 feet; and an inch in the horizontal scale corresponds to 284 miles. *a*. Mouth of Kansas River. *b*. St. Vrain's Fort. *c*. Laramie River. *d*. South Pass. *e*. Dividing range. *f*. Beer Springs. *g*. Great Salt Lake. *h*. Fort Hall. *i*. Crossing of Snake River. *k*. Blue Mountains. *l*. Fort Wallawalla. *m*. Dalles. *n*. Cascades. *o*. Fort Vancouver. *p*. Mount St. Helen's.

It corrects at once a common impression that these mountains are a narrow line of heights, showing that they stretch over a breadth of twelve or fifteen hundred miles, and that the ridges at summit like those on some parts of the declivities, are properly ranges of heights upon the great Rocky Mountain elevation. To be fully apprehended, it should be observed that, although the inclination in the above view is so gradual, the height as related to the breadth is actually on the scale adopted, exaggerated *thirty times*. The pass which was followed by Captain Frémont, called the South Pass and situated in latitude 42° 24′ 32″, longitude 109° 26′, was found to be 7,490 feet above the sea.

In the journey of Capt. Frémont south from Fort Vancouver into California, the party crossed the Cascade range (or, as it is called in that part, the Sierra Nevada) at a height of 9,338 feet, which is nearly 2,000 feet above the Rocky Mountain pass, and "several peaks in view rose several thousand feet higher." Thus within 150 miles of the coast, and 500 from the summits of the Rocky Mountains, there is a range of heights even exceeding this chain in elevation. This Cascade range extends north and south through Oregon into California, and contains several lofty volcanic cones, from 10 to 15,000 feet in altitude; two of them, St. Helen's and Mount Regnier, are stated by Captain Frémont to have been in action at the time of his visit; and he adds that "on the 23d of the preceding November, St. Helen's had scattered its ashes like a light fall of snow over the Dalles of the Columbia."

On the ascent of the Rocky Mountains, specimens of the rocks and several interesting fossils were collected. As observed by Major Long, sandstones are most abundant; but in many places the rock is calcareous and passes into an earthy whitish or yellowish limestone, often porous or appearing sandy; and this again is occasionally finely laminated. Sand and gravel cover the larger part of the surface between the Missouri and the Mississippi. From an examination of the fossils, Mr. James Hall concludes that the cretaceous formation to which the limestone belongs, extends at least to a height of 5,000 feet above the sea. On Smoky Hill river, in latitude 39° and longitude 98°, the rock was an impure limestone and abounded in shells of a species of Inoceramus. The height of the place was about 1,500 feet above the sea. Near Fort St. Vrain in latitude 105°, and at an altitude of 5,500 feet, a similar rock was observed, upon which Mr. Hall remarks that "two fragments of fossils still indicate the cretaceous period; but the absence of any perfect specimens must deter a positive opinion upon the precise age of the formation; yet one specimen from its form, markings and fibrous structure, I have referred to the genus Inoceramus." "The whole formation," as Mr. Hall adds respecting the seven degrees of longitude travelled over to the place just mentioned, "is probably, with some variations, an extension of that which prevails through Louisiana, Arkansas and Missouri." Beyond St. Vrain's Fort, the region towards the Wind river mountains changes to granitic. Yet sandstones and shales prevailed farther north, near Frémont's pass and beyond, with some thin beds of coal, which Mr. Hall suggests may possibly belong to the oolitic period. In longitude 111° and latitude 41½°, on Muddy river, the rock was a "yellowish gray oolitic limestone, containing turbo and cerithium," and not far distant fossil ferns were obtained, among which was one species resembling the *Glossopteris Phillipsii*, an oolitic fossil. Mr. Hall remarks, "this

species alone, with the general characters of the other species, and the absence of the large stems so common in the coal period, had led me to refer them to the oolitic period: I conceive however, that we have scarcely sufficient evidence to justify this reference."

At the Cascades on the Columbia, tertiary beds and fossils were met with, and the same rock occurs towards the mouth of the river.

The Great Salt lake, called also Lake Timpanogos, and Lake Youta, was examined in September, 1843, and this party was the first which had visited one of its islands. The elevation of the surface was ascertained to be 4,200 feet above the sea. The rock here observed was a talcose rock or steatite. Standing on the summit of the island 800 feet high, to which they had passed in an India rubber boat, they had "an extended view of the lake, enclosed in a basin of rugged mountains, which sometimes left marshy flats and extensive bottoms between them and the shore, and in other places came directly down to the water, with bold and precipitous bluffs. To the southward, several peninsular mountains, 3000 or 4000 feet high entered the lake, appearing, so far as the distance and our position enabled us to determine, to be connected by flats and low ridges with the mountains in the rear." The cliffs around were much incrusted with salt from evaporation, and saline flats and plants in many places bordered the lake. The area of the lake as laid down on the map, is about 2000 square miles, and its highest northern point is in latitude 41° 48′. A portion of the salt obtained by evaporation was afterwards analyzed, and found to consist of common salt 97·80, chlorid of calcium 0·61, chlorid of magnesium 0·24, sulphate of soda 0·23, sulphate of lime 1·12.

The lateness of the season hurried our explorers from this region before it could be thoroughly surveyed. There is a smaller lake to the south (Lake Utah) connected with the Great Salt Lake like Lake George with Champlain, which Captain Frémont visited on his return and found to consist of fresh water.

Various thermal and mineral springs were met with on the different journeys, and efflorescent salts often abounded over the dry soil. One region of carbonated springs was met with on the *Fontaine-qui-bouit* river, in longitude 105° 23′. Another, the Beer springs, on Bear river, not far above the Great Salt Lake, is noticed as follows.

"Although somewhat disappointed in the expectations which various descriptions had led me to form of unusual beauty of situation and scenery, I found it altogether a place of very great interest; and a traveller for the first time in a volcanic region remains in a constant excitement, and at every step is arrested by something remarkable and new. There is a confusion of interesting objects gathered together in a small space. Around the place of encampment the Beer springs

were numerous; but, as far as we could ascertain, were entirely confined to that locality in the bottom. In the bed of the river, in front, for a space of several hundred yards, they were very abundant; the effervescing gas rising up and agitating the water in countless bubbling columns. In the vicinity around were numerous springs of an entirely different and equally marked mineral character. In a rather picturesque spot, about 1,300 yards below our encampment, and immediately on the river bank, is the most remarkable spring of the place. From an opening on the rock, a white column of scattered water is thrown up, in form like a *jet-d'eau*, to a variable height of about three feet, and, though it is maintained in a constant supply, its greatest height is attained only at regular intervals, according to the action of the force below. It is accompanied by a subterranean noise, which, together with the motion of the water, makes very much the impression of a steamboat in motion; and, without knowing that it had been already previously so called, we gave to it the name of the *Steamboat spring*. The rock through which it is forced is slightly raised in a convex manner, and gathered at the opening into an urn-mouthed form, and is evidently formed by continued deposition from the water, and colored bright red by oxide of iron. An analysis of this deposited rock, which I subjoin, will give you some idea of the properties of the water, which, with the exception of the Beer springs, is the mineral water of the place.* It is a hot spring, and the water has a pungent and disagreeable metallic taste, leaving a burning effect on the tongue. Within perhaps two yards of the *jet-d'eau* is a small hole of about an inch in diameter, through which, at regular intervals, escapes a blast of hot air with a light wreath of smoke, accompanied by a regular noise. This hole had been noticed by Doctor Wislizenus, a gentleman who several years since passed by this place, and who remarked, with very nice observation, that smelling the gas which issued from the orifice produced a sensation of giddiness and nausea. Mr. Preuss and myself repeated the observation, and were so well satisfied with its correctness, that we did not find it pleasant to continue the experiment, as the sensation of giddiness which it produced was certainly strong and decided. A huge emigrant wagon, with a large and diversified family, had overtaken us and halted at noon at our encampment; and, while we were sitting at the spring, a band of boys and girls, with two or three young men, came up, one of whom I asked to stoop down and smell the gas, desirous to satisfy myself further of its effects. But his natural caution had been awakened by the singular and suspicious features of the place, and he declined my proposal decidedly, and with a few indistinct remarks about the devil, whom he seemed to consider the *genius loci*. The ceaseless motion and the play of the fountain, the red rock, and the green trees near, make this a picturesque spot.

"A short distance above the spring, and near the foot of the same spur, is a very remarkable yellow-colored rock, soft and friable, consisting principally of carbonate of lime and oxide of iron, of regular structure, which is probably a fossil coral. The rocky bank along the

* Carbonate of lime 92·55, carbonate of magnesia 0·42, oxyd of iron 1·05, silica, alumina, water and loss, 5·98 = 100·00.

shore between the Steamboat spring and our encampment, along which is dispersed the water from the hills, is composed entirely of strata of a calcareous *tufa* containing the remains of moss and reed-like grasses, which is probably the formation of springs. The *Beer* or *Soda springs*, which have given name to this locality, are agreeable, but less highly flavored than the *Boiling springs* at the foot of Pike's peak, which are of the same character. They are very numerous, and half hidden by tufts of grass, which we amused ourselves in removing and searching about for more highly impregnated springs. They are some of them deep, and of various sizes—sometimes several yards in diameter, and kept in constant motion by columns of escaping gas. By analysis, one quart of the water contains as follows:

	Grains.
Sulphate of magnesia,	12·10
Sulphate of lime,	2·12
Carbonate of lime,	3·86
Carbonate of magnesia,	3·22
Chloride of calcium,	1·33
Chloride of magnesium,	1·12
Chloride of sodium,	2·24
Vegetable extractive matter, &c.	0·85
	26·84"

pp. 136, 137.

Travelling along, east of the Cascade range, many fine lakes were met with, and in latitude 40° 40′, another remarkable locality of hot springs.

"This is the most extraordinary locality of hot springs we had met during the journey. The basin of the largest one has a circumference of several hundred feet; but there is at one extremity a circular space of about fifteen feet in diameter, entirely occupied by the boiling water. It boils up at irregular intervals, and with much noise. The water is clear, and the spring deep; a pole about sixteen feet long was easily immersed in the centre, but we had no means of forming a good idea of the depth. It was surrounded on the margin with a border of *green* grass, and near the shore the temperature of the water was 206°. We had no means of ascertaining that of the centre, where the heat was greatest; but, by dispersing the water with a pole, the temperature at the margin was increased to 208°, and in the centre it was doubtless higher. By driving the pole towards the bottom, the water was made to boil up with increased force and noise. There are several other interesting places, where water and smoke or gas escape, but they would require a long description. The water is impregnated with common salt, but not so much so as to render it unfit for general cooking; and a mixture of snow made it pleasant to drink.

"In the immediate neighborhood, the valley bottom is covered almost exclusively with chenopodiaceous shrubs, of greater luxuriance, and larger growth, than we had seen in any preceding part of the journey."—p. 215.

The lakes passed among the ridges of the Cascade range, were remarkable for their beauty and the singularity of their

situation. We close this notice with Captain Frémont's remarks on *Pyramid Lake*, a short distance only from the Boiling springs just noticed. Ascending the mountain by a broad pass they reached the summit, beyond which—

"A defile between the mountains descended rapidly about two thousand feet; and, filling up all the lower space, was a sheet of green water some twenty miles broad. It broke upon our eyes like the ocean. The neighboring peaks rose high above us, and we ascended one of them to obtain a better view. The waves were curling in the breeze, and their dark-green color showed it to be a body of deep water. For a long time we sat enjoying the view, for we had become fatigued with mountains, and the free expanse of moving waves was very grateful. It was set like a gem in the mountains, which, from our position, seemed to enclose it almost entirely. At the western end it communicated with the line of basins we had left a few days since; and on the opposite side it swept a ridge of snowy mountains, the foot of the great Sierra. Its position at first inclined us to believe it Mary's lake, but the rugged mountains were so entirely discordant with descriptions of its low rushy shores and open country, that we concluded it some unknown body of water; which it afterwards proved to be.

"On our road down, the next day, we saw herds of mountain sheep, and encamped on a little stream at the mouth of the defile, about a mile from the margin of the water, to which we hurried down immediately. The water is so slightly salt, that, at first, we thought it fresh, and would be pleasant to drink when no other could be had. The shore was rocky—a handsome beach, which reminded us of the sea. On some large *granite* boulders that were scattered about the shore, I remarked a coating of a calcareous substance, in some places a few inches and in others a foot in thickness. Near our camp, the hills, which were of primitive rock, were also covered with this substance, which was in too great quantity on the mountains along the shore of the lake to have been deposited by water, and has the appearance of having been spread over the rocks in mass.*

"The next day, we followed again a broad Indian trail along the shore of the lake to the southward. For a short space we had room enough in the bottom; but, after travelling a short distance, the water swept the foot of precipitous mountains, the peaks of which are about 3,000 feet above the lake. The trail wound along the base of these precipices, against which the water dashed below, by a way nearly impracticable for the howitzer. During a greater part of the morning the lake was nearly hid by a snow storm, and the waves broke on the

* The label attached to a specimen of this rock was lost; but I append an analysis of that which, from memory, I judge to be the specimen.

Carbonate of lime,	77·31
Carbonate of magnesia,	5·25
Oxide of iron,	1·60
Alumina,	1·05
Silica,	8·55
Organic matter, water, and loss,	6·24
	100·00

narrow beach in a long line of foaming surf, five or six feet high. The day was unpleasantly cold, the wind driving the snow sharp against our faces; and, having advanced only about twelve miles, we encamped in a bottom formed by a ravine, covered with good grass, which was fresh and green.

"We did not get the howitzer into camp, but were obliged to leave it on the rocks until morning. We saw several flocks of sheep, but did not succeed in killing any. Ducks were riding on the waves, and several large fish were seen. The mountain sides were crusted with the calcareous cement previously mentioned. There were chenopodiaceous and other shrubs along the beach; and, at the foot of the rocks, an abundance of *Ephedra occidentalis*, whose dark-green color makes them appear like evergreens among the shrubby growth of the lake. Towards evening the snow began to fall heavily, and the country had a wintry appearance.

"The next morning the snow was rapidly melting under a warm sun. Part of the morning was occupied in bringing up the gun; and, making only nine miles, we encamped on the shore, opposite a very remarkable rock in the lake, which had attracted our attention for many miles. It rose, according to our estimate, 600 feet above the water; and, from the point we viewed it, presented a pretty exact outline of the great pyramid of Cheops. The accompanying drawing presents it as we saw it. Like other rocks along the shore, it seemed to be incrusted with calcareous cement. This striking feature suggested the name for the lake.

"The elevation of this lake above the sea is 4,890 feet, being nearly 700 feet higher than the Great Salt lake, from which it lies nearly west, and distant about eight degrees of longitude. The position and elevation of this lake make it an object of geographical interest. It is the nearest lake to the western rim, as the Great Salt lake is to the eastern rim, of the Great Basin which lies between the base of the Rocky Mountains and the Sierra Nevada."—pp. 216, 217, 218.

The work is illustrated by many fine views of scenery, besides five plates of fossils, and four of recent plants. There was no retinue of science attached to the expedition, yet by personal exertion, in connection with his other arduous duties, Captain Frémont made valuable geological and botanical collections. Unfortunately, a considerable portion of them were lost by accidents from which our travellers barely escaped with their lives. Part of the specimens preserved are described in the volume by Prof. J. Torrey. We observe one genus dedicated to Captain Frémont, (Fremontia.) It is right that this bold explorer of the mountains should have his name inscribed among the flowers of the region, and about its loftiest heights, as well as upon the honored page of history.

ART. XXIII.—*Hybridity in Animals, considered in reference to the question of the Unity of the Human Species;* by SAMUEL GEORGE MORTON, M. D.

(Continued from p. 50, this volume.)

PART II.—BIRDS.

Gallinaceous Hybrids.—The variation of size, form and plumage, so remarkable among the different breeds of domestic fowls, has been usually attributed to the action of physical agents on a single, original species. This supposition however, is now found to be untenable; for the best ornithologists, and those, too, who have no view to collateral generalization, have succeeded in tracing this family of birds to, at least, ten different species. Without appealing to unnecessary details it is sufficient to observe, that independently of certain admitted changes as the result of domestication, these birds are in far greater degree modified by the power possessed by their several species, (so far, at least, as the experiment has been extended,) of mingling with each other and producing a fertile hybrid progeny. Hence, in a great measure, those interminable varieties of exterior form, size and color now everywhere familiar.*

The *Gallus ecaudatus* (tail-less fowl) has been triumphantly quoted as an evidence of the power of climate and locality to produce changes, not only of plumage, but of anatomical conformation. This bird is deficient in the last dorsal vertebræ, and consequently has no tail. But it was asserted, even by some naturalists, that this fowl was originally possessed of a tail, but lost it on being sent from England to Virginia, and domesticated in the latter country. More recent investigations, however, have proved, that this is a wild, native species of Ceylon.†

The fowl with rumpled or inverted feathers, which was long regarded as a mere accidental variety, is now believed to be a distinct species, and a native of Guiana. It breeds with all the other domestic fowls, and the offspring is prolific without end.

Fortunately for the further elucidation of this question, the continent of America produces a family of gallinaceous birds,—the *Alectors* of ornithologists,—among which the very same in-

* We have been at some pains to ascertain the specific names of the several *original* gallinaceous birds; yet without presuming that ornithologists have described all that exist, we append a list of such as are already known: *Gallus bankiva; G. æneus; G. Anstrutheri; G. furcatus; G. Sonnerutii; G. Lafayettii; G. giganteus; G. morio; G. lanatus; G. ecaudatus,* and *G. crispus.* I omit several supposed species which may, for the present, be regarded as apocryphal. I have had the pleasure of examining *five* of these original species, contained in the magnificent *Wilson Collection of Birds*, now deposited, by its liberal proprietor, in the Academy of Natural Sciences of Philadelphia.

† Griffith's Cuvier, viii, pp. 19, 21, 173.—Temminck, as quoted in the same work.

termixture of species takes place, and consequent fertile offspring, as we have remarked in the several species of domestic fowls. All the *Hoccos* or Currasows (Crax) for example, which are derived from their native forests of Guiana, readily unite with each other, giving rise to a progeny that is reproductive without end. "It is probable," observes a judicious ornithologist, "that if the intercourse were repeated in a variety of ways, it would be possible to cultivate, by suitable care, many different races of these birds, whose descendants might be susceptible of multiplying, *ad infinitum*, and branching out into a number of singular varieties, under the superintendance of man."*

In fact, the Dutch menageries have already obtained the prolific hybrids of three species† of this genus; and it has been observed that these mixed birds have their plumage more varied, and far more agreeable to the eye, than the uniform livery of the adult individuals of the pure race.‡

Here, then, we have a family of wild birds, recently reclaimed from their native forests, so as to leave no possible question of their origin and specific diversity; and by intermixing these species in a state of domestication, we have passing under our eyes, as it were, the identical series of phenomena, those very same changes, which are so remarkable and so familiar in the common fowl.

Since I commenced writing this essay, I have met with two hybrid gallinaceous birds, between the common fowl and the Guinea fowl (Numida meleagris). They were bred in the state of Delaware, and possess, in a remarkable and unequivocal manner, the exterior characters and the habits of both parents. One of them looks more like the common fowl; the other, on the contrary, has a much stronger resemblance to the Guinea fowl. The sounds which they utter are intermediate, often analogous to those of the Guinea fowl, but occasionally having the *cluck* of the other parent. These birds are yet living, and their sex has not been positively determined, but the male characters appear to predominate.

Since they came under my notice, I have heard of three other examples of similar hybrids occurring in different parts of the United States; but no progeny has resulted from them.§

Bechstein states that the cock of the wood (*Tetrao urogallus*) will breed with the black grouse (*T. tetrix*) and even with the domestic fowl and turkey. White of Selborne‖ gives a plate

---

* Griffith's Cuvier, viii, p. 100.

† *Crax alector*, *C. rubra* and *C. globicera*.

‡ Griffith's Cuvier, viii, p. 113.

§ See Proceedings of the Academy of Natural Sciences of Philadelphia, for September, 1846.

‖ Naturalist's Calendar, for 1795.

and description of a wild hybrid, between the pheasant and domestic fowl; and a bird of the same kind was preserved in the Leverian museum at Oxford. A similar example is again recorded by Mr. Eyton, in his History of the rarer British Birds, in which five individuals were produced.*

Further, the common ring-pheasant of England, is now ascertained to be a hybrid between the *Phasianus colchicus* and *P. torquatus* of China. This cross is very prolific, and is said to be spreading faster than the ordinary breed.† In fine, we are informed on the best authority that "many of the birds which compose the gallinaceous order, appear to be less difficult to be brought to unite with strange species, than those of any other order. From the great majority of the pheasants, mongrels may be thus produced. All the *hoccos* (Crax) will couple in a state of domestication; the pheasant will ally with the cock; the last with the turkey, with which, also, the hoccos, born in the domestic state, will also unite. It appears, in fact, very possible to produce mongrels from the major part of those Gallinæ which are susceptible of cultivation."‡

Hybrids of the Fringillidæ.—The Finch family furnishes another example of an extensive amalgamation of species, and a remarkable series of prolific hybrids. Thus, according to Bechstein, the Redpole (Fringilla linaria) will breed with the goldfinch, linnet and canary; while the cross between the latter and the goldfinch is capable of reproduction.

The Citril finch (F. citrinella) also, readily pairs with the canary, and gives rise to a fertile offspring; and, indeed, so remarkable is the fecundity of these hybrids, and the ease with which they reproduce with the goldfinch, bullfinch and greenfinch, that M. Veilliot, in order to account for a phenomenon that conflicted with the prevalent opinion of the sterility of all hybrids, assumed that the *F. citrinella* and *F. canaria* were not distinct species, but only two races that had sprung from the same stock; and that one having colonized in Europe and the other in the Canary islands, their different characteristics were owing to a mere difference of locality.§

On the other hand, those persons, who, for pastime, have given great attention to this subject, are of the opinion that the cage-canary is not derived only from the *Fringilla canaria;* but that it is, itself, a fertile hybrid, of which there now exist upwards of thirty various breeds.

Syme, who has written on the British song-birds, says that the wild canaries of the islands that bear that name, have less resem-

* Proceedings of the Zoolog. Society of London, 1835.
† Rennie, in Montagu's Ornithological Dict., p. 424.
‡ Griffith's Cuvier, viii, pp. 173, 175, 176.—Prichard. Researches, &c., i, p. 140.
§ Griffith's Cuvier, vii, p. 271.

blance in song and plumage, to the domestic canary, than to the *Siskin* of Germany, the *Venturon* of Italy, or the *Serin* of France.

The celebrated ornithologist Bechstein, adds the following remarks: "We might almost conclude that the *Venturon* (F. citrinella), the *Serin* (F. serinus) and the *Siskin* (Carduelis spinus), are the wild originals of the cage-canary. I have seen a bird produced between the *Siskin* and *Serin* which perfectly resembled the variety called the green canary;—I have, also, seen a mule from a grey female canary, whose true parentage could not be distinguished." The Siskin, it will be observed, belongs to a different genus from the wild canary.

The canary is now known to breed, not only with the three species just mentioned, but also, with the goldfinch, linnet, sparrow, chaffinch, bunting, greenfinch and bullfinch; and with several of them, it produces a fertile offspring.

M. Veilliot once caught a mule bird, which he supposed to be the produce of a male greenfinch (F. chloris) and a female goldfinch; for it mingled the size, color and song of both these species. This bird did not appear to have resulted from the domestication of the parents, for it remained extremely wild, yet was brought to couple with a female canary.*

A yet more remote alliance, that between a canary and a nightingale, produced an egg that could not be hatched. This fact conjoined with others to which we have adverted, illustrates the remark of Prof. Temminck, that the occurence of prolific offspring between different species of birds, is an evidence of the near affinity between them; and that when the reverse takes place (infertile mules) it proves the disparity between the species thus brought together.

Hybrids of the Anatidæ.—The cross between the *Anser cygnoides* and the common tame goose of Europe, is proverbially frequent, and the offspring has proved prolific.† Mr. Eyton and Mr. Blyth have recorded examples of this kind, and M. Chevreul has seen the progeny extended through seven generations.‡

The *Anser canadensis* is often taken in the United States and reduced to the domestic state, in which it crosses with our common goose, producing a hybrid offspring, which, however, appears to be sterile.

The swan (Cygnus olor) has crossed with the common European goose, but I am not aware that the hybridity has been noticed beyond the first offspring. This fact is quoted by Dr. Prichard, from M. Frederick Cuvier.

---

* Griffith's Cuvier, vii, p. 259.

† London's Magazine, ix, p. 511. Temminck, Manuel d'Ornithologie, i, p. 109. —Eyton, Monograph of Anatidæ.

‡ Journal des Savans, June, 1846.

Mr. Charles Waterton, the celebrated traveller, has published a very interesting account of a hybrid between the female Canada goose, and the wild Bernacle gander (Anser bernicla).* This fact occured at Mr. Waterton's seat at Walton Hall, England. "These hybrids," he observes, "are elegantly shaped, but are not so large as the mother, nor so small as the father, their plumage partaking in color with that of both parents. The white on their front is only half as much as is seen on the front of the gander, while their necks are brown in lieu of the coal-black color which appears on the neck of the goose. Their breasts, too, are of a dusky color, while the breast of the bernacle is black, and that of the Canadian, white; and throughout the whole of the remaining plumage there may be seen an altered and modified coloring, not to be traced in that of the parent birds."†

It remains to notice some instances of hybridity among different species of ducks; thus a cross has been obtained between the *Anas fuligula* of Europe, and the European teal (Anas querquedula).‡ "Selby mentions a male wigeon (Mareca penelope) breeding with a female pintail (Anas acuta), notwithstanding the fact of females of his own species being kept on the same piece of water." Other crosses have taken place between the pintail and the common mallard (Anas boschas);§ and in the wild state, between the latter and the dusky duck (A. obscura), of which my friend Mr. William Gambel, has seen a specimen in the possession of Mr. J. G. Bell, of New York, near which city it was shot. A much more frequent hybrid occurs between the mallard and muscovy duck (A. moschata).

Mr. William R. Clapp informs me that he saw, at Rye Pond, in the state of New York, a female wild duck that had been taken when young and placed in company with the common tame species, and that a fertile hybrid progeny was obtained from them. From the description of this wild bird, I suppose it to have been the *Anas rurfitorques.*

Other Hybrid Birds.—Among bird-hybrids it only remains to notice those of *Motacilla lugubris* and *M. alba*, as recorded by Temminck, and which possessed color and markings intermediate between both parents.‖ A mixed breed has been repeatedly observed in Scotland between the common crow (Corvus corone), and the hooded crow (C. cornix), and another mixed species between the latter bird and the carrion crow. Finally, a hybrid has been obtained between the throstle (Turdus musicus) and the black-bird (Merula vulgaris) of Great Britain.¶

---

* Bernicla brenta.
† Essays on Nat. History, p. 118, 2d edition.
‡ Prichard. Researches, &c., i, p. 140, from M. Geoffroy St. Hilaire.
§ Loudon's Magazine, ix, p. 615.
‖ Manuel d'Ornithologie, i, p. 254. ¶ Loudon's Magazine, ix, p. 615.

Hybrid Reptiles, Fishes, Mollusca and Insects.

Among reptiles, I have found but a single authenticated example, that of a cross between the European frog and toad, which are generically distinct. (Bufo and Rana.)*

Among fishes, specific hybrids have been obtained by means of artificial impregnation between *Cyprinus carpio*, and *C. carassias*, and between the former species and *C. gibellio*.† "Defay mentions a hybrid between the *barbus* and *carpio*, and Bloch a similar production intermediate between *Cyprinus blicco* and *C. brama*."‡

My friend Mr. S. S. Haldeman, well known for his many and accurate contributions to various branches of natural science, has kindly furnished me with the following note in relation to some American freshwater Mollusca, in connexion with the present inquiry.

"Whilst I deem *Unio radiatus* and *U. siliquoideus* distinct species, there is a certain variety, apparently of the latter, although almost precisely intermediate, which induces me to believe it may possibly be a hybrid. I have never, however, seen any thing like a hybrid between the other species inhabiting the eastern waters of the United States, although I have had many opportunities for observation.

"In their proper localities no species can be more readily separated than *Paludina decisa* and *P. ponderosa;* yet intermediate individuals occur which it is extremely difficult if not impossible to give an undoubted place with either. This difficulty has sometimes almost induced me to regard the two as one species; but when I found that the best developed specimens of *P. decisa* never take the form of *P. ponderosa* where the latter is not found, as in the waters east of the Alleghanies, I could not safely unite them. Perhaps hybridity may be the cause of the difficulty where the two species occur in the same locality."

In Entomology, Mr. Haworth has published some highly interesting facts relating to hybrid productions, and particularly in respect to the genus *Coccinella*. Fabricius had noticed and published some of these facts; but Dr. Prichard remarks, that they "do not afford an unequivocal example of the union of different species, since, according to the opinion of Illiger, accidental varieties of the Coccinella have been frequently mistaken for distinct kinds."§ Yet on the other hand, Mr. Haworth asserts that he has often seen, *in coitû*, several different species of this genus; and he adds the following observations:

"That they mix sexually with each other, when their proper mates cannot be found, is well known; and I have even had

* Brande's Dict. of Science, &c., Art. Hybrid.
† Ibid.
‡ Prichard. Researches, &c., i, p. 140.
§ *Ut supra.*

larvæ produced from the union of *C. tripunctata*, and *C. quadripustulata*, which, but for an accident, would have been reared. Yet such junctions cannot destroy the distinctions of the primitive species, although it may give birth occasionally to hybrid broods; not barren, but capable of generating, for a while, others like themselves. Such, in all probability, are *Coccinella annulata* and *C. fasciata*. If these two had never existed, no Entomologist would have conceived that all the insects of this section and *C. bipunctata*, were of the same species! Wherefore it follows that they are not."

"Practical entomologists well know that similar unions happen in other genera, but more especially in *Cicada*; and from them arise occasionally a set of hybrid varieties, which still do not overturn the primitive distinctions of the original species whence they sprung; however difficult they may sometimes render the task of discriminating amongst such a set of mongrel productions.

"It is even probable that two species of distinct sections may occasionally generate a race very different from both parents, yet resembling both, and not barren, as is usually the case with mules, but capable of procreating. And such a brood some hold to be a new and distinct species in the scale of nature—brought to light by her own operations, and in the very same way that she has occasionally multiplied, and still continues to increase, the stupendous members of the vegetable kingdom."*

Hybrid Plants.

Dr. Prichard, as the result of extensive inquiry, informs us that the number of hybrid plants in the wild or uncultivated state, is about forty; that a few of these have reproduced, but that the greater part of them are sterile.† On the other hand, it is asserted by Shiek, that a multitude of plants produce specifical hybrids in a state of nature.‡

There are innumerable instances, as every one knows, of crosses obtained from plants of different species of the same genera, even when brought from the most distant parts of the world, as the experiments of Kolrenter, Sagaret and Herbert abundantly testify. Not only are these hybrids fertile, but in some instances their reproductiveness exceeds that of the parent plants, by multiplying not only from the seed, but from roots, shoots and suckers. The intermixture is not confined to particular species, but even the most dissimilar can be crossed. We think it unnecessary to give examples when the facts are available to every one; and therefore in respect to the blending of *species* among plants, the reader

* Trans. of the Entomological Soc. of London, i, pp. 267, 291.
† Researches, &c., i, p. 139.
‡ Brande's Dict. of Science, Art. Hybrid.

is particularly referred to the admirable essays of the Rev. Mr. Herbert, and M. Sagaret.*

We may remark, however, that so abundant are these hybrids, that Mr. Herbert, in order to avoid the difficulty they present to a favorite theory, declares it as his opinion, that botanical species are only a higher and more permanent class of varieties, which should be discarded from the systems, leaving the *genera* to define the individuality of kind; or, in other words, to designate those permanent characteristics, which have hitherto, in his opinion, been erroneously attributed to species.†

But in the treatise of M. Sagaret, various instances are given of hybrid plants derived from the mixture of different genera; thus realizing, in this department of nature, the same facts that we have seen to occur in the several sections of the zoological series. We will offer a single example,—the cross between the horse-radish (Cochlearia raphanus) and the cabbage; the former bearing a short pod, or *silicula*, the latter a long pod or *siliqua*.

Remarks.

While we admit that hybrids, as a general law, are contrary to nature, we are also compelled to concede that this law has very many exceptions. "It is manifest," says Dr. Prichard, "that there is some principle in nature which prevents the intermixture of species, and maintains the order and variety of the animal creation. If different species mixed their breed, and hybrid races were often propagated, the animal world would present a scene of confusion. By what method is this confusion prevented? The fact seems to be, that the tribes of wild animals are preserved distinct, not only by the sterility of mules, but that such animals are never, in the state of nature, brought into existence. The separation of distinct species is sufficiently provided for by the *natural repugnance* between individuals of different kinds. This is, indeed, overcome *in the state of domestication*, in which the natural propensities cease, in a great measure, to direct their actions."‡

But we have seen that mules are not always sterile, and also that hybrids are really produced in a state of nature, wholly independent of the influence of cultivation; facts which, indeed, are admitted and illustrated by Dr. Prichard in his later writings. That domestication evolves the faculty of hybridity there can be no question; and we would apply the principle to various classes of animals. It will materially assist in explaining so great a variety in some animals, by pointing, as De Azara and Hamilton Smith

* Herbert. Amaryllidaceæ. *Introd.*—Sagaret. Annales des Sciences Nat., T. viii. † Amaryllidaceæ, p. 19.

‡ Researches into the Physical History of Mankind, i, p. 97. *Second Edition.*

have suggested, to certain primitive species, which were endowed with the capacity for reproducing among themselves, especially under the influence of domestic culture. We have shown that this fact is unquestionable among some quadrupeds and some birds, of which the hybrid varieties have been cultivated for the uses of man.

Could we trace back the origin and history of various other species, we should, in all probability, arrive at the very same result; for it appears to be a law of nature, that the faculty possessed by different species of animals of producing fertile hybrid offspring, is in proportion to their aptitude for domesticity.

Now, since man possesses this aptitude in the highest degree, being as Blumenbach expresses it, the most domestic of animals, it would be nothing singular if he possessed the power of fertile hybridity, even if the human family should prove to embrace several distinct species; because, as we have fully shown, this phenomenon is not unfrequent among animals, whose specific, and even generic diversities, are unquestionable. If, therefore, domestication, or as we have termed it, the aptitude for domesticity, explains the fact in one instance, it certainly does so in the other; more especially since fertile reproduction has ceased to be evidence of identity of species.

A word with respect to the theory of *repugnance*. The same phenomena, moral as well as physical, take place, to a certain extent, among men as among animals; for the repugnance of some human races to mix with others, has only been partially overcome by centuries of proximity, and, above all other means, by the moral degradation consequent to the state of slavery. Not only is this repugnance proverbial among all nations of the European stock among whom negroes have been introduced, but it appears to be almost equally natural to the Africans in their own country, towards such Europeans as have been thrown among them; for with the former a white skin is not more admired than a black one is with us.*

---

* See the travels of Hawkins, Browne, Burkhardt, Caillet, &c., for abundant evidence of this fact.

I must here be permitted to offer a single additional remark. It is obvious that while cultivation produces obvious changes in some animals, its influence has had little or no effect on others; for example, the ass, the rat, and the mouse, among quadrupeds, and the peacock and guinea fowl among birds. These species have been domesticated from immemorial time, in all latitudes, under every conceivable variety of circumstances. Among wild birds and quadrupeds, on the other hand, some undergo very remarkable changes in a state of nature, as some species of squirrel, fox, wolf, &c., while other species of the very same genera undergo no change whatever. Hence the fallacy of drawing inferential conclusions from those that *do* change, in order to explain the phenomena of diversity among men.

The diversities of animals are in some cases owing to exterior causes alone; in other intances they arise solely from amalgamation of species; while in a third class we can trace the operation of both these agents.

Conclusion.

1. A latent power of hybridity exists in many animals in the wild state, in which state, also, hybrids are sometimes produced.

2. Hybridity occurs not only among different species, but among different genera; and the cross-breeds have been prolific in both cases.

3. Domestication does not cause this faculty, but merely evolves it.

4. The capacity for fertile hybridity, *cæteribus paribus*, exists in animals in proportion to their aptitude for domesticity and cultivation.

5. Since various different species of animals are capable of producing together a prolific hybrid offspring, hybridity ceases to be a test of specific affiliation.

6. Consequently, the mere fact that the several races of mankind produce with each other, a more or less fertile progeny, constitutes, in itself, no proof of the unity of the human species.

ART. XXIV.—*Abstract of a Meteorological Journal, for the year* 1846, *kept at Marietta, Ohio,* Lat. 39° 25′ N., and Long. 4° 28′ W. of Washington City; by S. P. HILDRETH, M. D.

MONTHS.	THERMOMETER.							BAROMETER.		
	Mean temperature.	Maximum.	Minimum.	Fair days.	Cloudy days.	Rain and melted snow. Inches.	Rain and melted snow. Hundths.	Prevailing winds.	Maximum.	Minimum.	Range.
January, - -	33·00	55	3	13	18	3	25	S. W. & N. & W.	29·95	29·05	0·90
February, -	31·33	57	6	14	14	2	33	W., N. & S. W.	29·90	28·95	0·95
March, - -	43·33	70	13	17	14	2	37	W., N. & S. E.	29·70	29·00	0·70
April, - -	51·00	89	24	19	11	2	04	S. W., W. & E.	29·85	29·18	0·67
May, - -	65·33	86	37	18	13	1	37	S. S. W. & N.	29·58	29·10	0·48
June, - -	67·00	84	44	16	14	7	04	S. S. W. & E.	29·62	29·25	0·37
July, - -	72·00	92	49	21	10	6	20	S. W., N. & S. E.	29·65	29·25	0·40
August, - -	74·16	91	56	22	9	6	00	S. & S. E.	29·55	29·28	0·27
September, -	69·83	90	43	22	8	1	68	S. & S. W.	29·60	29·20	0·40
October, - -	52·66	79	24	18	13	4	00	S. W. & N.	29·75	29·10	0·65
November, -	46·33	67	10	10	20	3	55	N. N. W. & E. S. E.	29·80	29·12	0·68
December, -	37·77	65	14	11	20	6	44	W. N. W. & E. N. E.	29·95	29·10	0·85
Mean for year,	53·64					46	27				

Remarks on the year 1846.—The mean temperature for the year is 53·64°, which is greater by about one degree than that of 1845, and considerably above the mean temperature for this place. The mean of the winter months is 29·91°—spring 53·22°—summer 71·05°—autumn 56·27°.

The year which has just closed, has been one of unusual fertility, having been remarkable for that regular distribution of heat and moisture, that would naturally produce a favorable result. Crops of all kinds have been good and abundant, especially that of fruit. Apples ripened much earlier than usual, owing to the warmth and moisture of the summer months, so that many of our winter varieties were changed into those of autumn, being mature a month earlier than usual, and causing a rapid decay of the fruit intended for winter use. Several of the winter kinds, especially greenings, ripened and fell to the ground in August, being a total loss except where they were cut and dried. Peaches also, suffered from the excessive rains of August, much of the fruit cracking open and decaying upon the trees. Grapes were greatly injured from the same cause. The warmth and moisture of June and July, caused a mildew to appear on the leaves and fruit, which could not be checked by the usual remedies, and the grapes perished in great quantities. On some vines a small insect destroyed the vitality of the leaves, and the crop could not ripen from a lack of the usual juices elaborated by them. The "potato rot," so ruinous to this vegetable in some parts of the world, did but little damage in this portion of Ohio—much less than in 1845; and it is to be hoped it may disappear altogether. No effectual remedy has been found; and as it came without any known cause, it may perhaps cease in the same manner.

The amount of rain and melted snow, is 46·27 inches; which is more than in 1845, by twelve or thirteen inches. The three summer months furnished nearly twenty inches, and the month of December six and a half inches, chiefly of rain. The Ohio river has been navigable for boats of a large size all the season. The mean temperature for the winter months, is about seven degrees colder than the winter preceding; severe weather commenced early, and the navigation of the Ohio was much obstructed with ice nearly all the winter. An abundance of this valuable article was formed to lay up for summer use, while the winter previous there was none frozen of sufficient thickness.

The mean temperature of the spring months, was 53·22°, which is a little below that of 1845, but was much more uniform and regular in temperature. That of March was nearly the same, while April was seven degrees colder, and May six degrees warmer, making the average temperature of the two springs nearly alike, while they varied considerably in the distribution; producing that beautiful variety so common to all the operations of nature, while the grand results of each year are nearly similar. No two springs could be more unlike; that of 1845 having been remarkable for the excessive, untimely frosts, and cold, drying winds; while that of 1846 was uniformly mild and pleasant, with no frost to injure the fruit blossoms, or blight the hopes of the florist.

The severe cold, however, of December previous, destroyed the blossoms and buds of that rich and showy flower, the Chinese tree Peony, so that not one in twenty ever expanded; showing that this plant needs some protection against the severe cold of our winters. This spring was remarkable for the appearance of the Cicada septendecim, or seventeen year locust, which was so abundant in this part of Ohio in 1829. (See beyond, page 216.)

Floral calendar for 1846, *migration of birds, &c.*—March 7th, the wild goose seen in flocks, flying towards the north, notes of the robin heard; 10th, garden Crocus in bloom; 15th, blue bird appears; 17th, martin seen; 22d, Hepatica triloba in blossom; 29th, black bird, in flocks.

April 4th, apricot tree in bloom, early hyacinth; 6th, Sanguinaria canadensis; 9th, wood Anemone, Juneberry or service tree, Pyrus japonicus; 10th, peach in bloom in warm exposures on side hills; 11th, dwarf iris, white maple in blossom, Corydalis cucullaria; 12th, crown imperial in blossom, and two and a half feet high, peach generally in bloom; 13th, red cherry; 17th, imperial gage; 18th, pear tree; 19th, Circas ohioensis, or Judas tree; 20th, harebell; 21st, peach tree shedding its blossoms, from the great heat of the weather; 22d, apple in blossom, Uvularia; 23d, Chickasaw plum, Ranunculus; 24th, tulip in full bloom, quince tree; 25th, Trillium thalictroides, Cornus florida; 27th, lilac, the whippowil heard; 28th, black hawthorn and hickory tree in bloom; 29th, purple mulberry; 30th, common or garden currant full size and fit for cooking, but not ripe. The hill sides are green with the foliage of forest trees, which have attained a size quite unusual at this season of the year.

May 1st, the fruit of the apricot is as large as a robin's egg; 2d, Tartarian honeysuckle in blossom; 5th, buck eye; 8th, double yellow rose; 9th, locust tree in blossom in warm exposures, which is ten days earlier than usual; 12th, rye in head; 13th, wild cherry, or Prunus virginiana; 16th, blackberry; 18th, white peony; 20th, wild grape in bloom; 23d, Peony fragrans, Juneberry and strawberry ripe; 24th, hardy roses generally in bloom; 25th, Syringa philadelphica, Osage orange, May dulce cherry ripe; 27th, wheat heading out; 29th, wheat in blossom, privet.

June 4th, white and orange lily in bloom; 6th, cucumbers, planted in the open ground, but germinated under boxes, fit for the table—apples dropping very much, from the punctures of the Curculio, which insect is becoming a serious annoyance to nearly all our fruits. The New England canker-worm has also appeared for the first time, in some of the apple orchards of Belprie; and on an island in the Ohio river, three miles below Marietta, they have destroyed the foliage of a large orchard. This destructive insect was probably introduced to the valley of the Ohio by

means of its eggs on one or more fruit trees, brought from the nurseries near Boston, as it first appeared near Cincinnati three or four years since. It will doubtless prove to be the greatest scourge to western fruit growers ever seen in the valley of the Ohio. 8th, purple mulberry ripe; 12th, Catalpa in blossom; 13th, Sambucus; 15th, common raspberry ripe; 16th, red Antwerp, wheat fields on warm sandy lands fit for harvesting; 17th, red cherry ripe; 20th, bass-wood tree in bloom; 29th, golden drop apple ripe; 30th, whortleberry and dewberry.

July 1st, early Chandler apple ripe; 3d, apricot ripe; 26th, water melon ripe.

August 31st, Indian corn ripe, and the farmers on the Ohio river cutting it up for harvest. The pastures on the hill sides, which usually at this season are dried up, are now as green as in April or May, owing to the abundant rains of this month; and they continued so through September.

Summer.—The mean temperature of the summer months is 71·05°, which is a little below that of 1845. There was a long continuation of heat, so that by most people it was considered the hottest summer they had ever known; but the thermometer, not so variable in its sensibilities as man, declares the heat not to be greater than that of ordinary years. The mercury at no time rose much above 92°, and only on a few days was as high as 90°. In September the heat was as great for the first fourteen days as in August, and there were seventeen days in which the temperature at 2 P. M. was at and above 80°, while in Sept., 1845, there were only seven days—so that this month was the hottest known for many years. This unusual heat ripened the fruit rapidly, and was the cause of its premature decay in the autumnal months, no year having been equal to this for the rotting of apples. The summer months were remarkable for the amount of rain, there falling nearly twenty inches in June, July and August, while in the year preceding there was less than twelve inches. The harvesting of grain began earlier than usual, while the crops were very abundant and fine, free from the destructive mildew which falls upon it in certain conditions of the atmosphere while the grain is in the milk. Indian corn was never better, and was ripe the last of August, or early in September. Potatoes, especially the early planted, were nearly free from the disease called "the rot," and the yield was as large as in any preceding year; while in 1845, many fields of the early planted yielded to the cultivator but little more than the seed planted, being destroyed by the frosts and drought of the spring months.

Autumn.—The mean of the autumnal months was 56·27°, being four degrees above that of the preceding year, which may be accounted for by the unusual heat of September. October and the fore part of November were very pleasant, but terminated

rather unexpectedly by a fall of snow from the northwest, of four or five inches on the 25th. On the 26th at sunrise the temperature was at 14°, and on the 27th at 10°. The cold continued only two days, and by the last of the month the snow had disappeared. This sudden severe weather injured much of the young tender wood of the grape vine and some other fruit trees. The first floating ice in the Ohio, was on the 22d of December. It remained only a few days, and the river has been navigable to the fore part of January, 1847, and twice since the winter commenced there were nearly full banks, from the great rains.

Cicada septendecim in 1846.—It is now seventeen years since, in 1829, this curious insect appeared in this portion of Ohio. Its exit from the earth, where it had remained excluded from the light of day for so long a time, was looked for with considerable interest. They were first seen to come out of the ground on the 14th of May, ascend some bush, fence, or tree, cast off their exuviæ, and become a flying insect. They had been observed, near the surface, since the beginning of April, and were turned up by the plough, and dug out of the earth by hogs, which were very fond of them, as were also birds, domestic fowls and cats. At a brick yard in Marietta, where the clay was dug from the side of a hill, under the remains of an old orchard of apple trees, the workmen observed the cells of this insect in 1838, in the large masses of earth, broken off from the side of the bank. In 1840, I visited the spot, collected several of the Cicadæ and preserved them in spirit. Their cells, at that time, were measured and found to be a third less than in the seventeenth year. The cells are oval and very smooth within, they are two and a quarter inches long and three fourths of an inch in diameter, being sufficiently large for the single Cicada, which inhabits it, to move and turn round. Thus they dwell for sixteen years and ten months secluded in a grotto of their own construction.

After the eggs of the female are deposited in the tender branches of trees, they remain two months or sixty days in the pith of the wood before they are hatched and ready to seek their home in the earth; and as they invariably ascend in May, soon after which the eggs are deposited, it makes their actual residence in the earth two months short of seventeen years. The perfect insect lives about thirty days, and then perishes. In 1840, the cells were found to be from two and a half to four feet below the surface; and without any tube communicating with the top of the ground. The cells are probably water proof, as the flood of 1832 covered the surface to the depth of six or eight feet in my garden. In 1846 a large number of these insects emerged from the earth under an apple tree, in the branches of which the parent Cicada had deposited her eggs in 1829. If the water at that time, when only in their third year, had had access to their cells,

they must have perished, for it remained over them five or six days. In their cells no appearance of excrementitious matter was noticed. When their period of entombment is completed, in the seventeenth year, or perhaps earlier, they commence working out a smooth cylindrical tube, towards the surface, taking care not to approach within reach of frosts, and where examined for the purpose, the tubes have been found to be usually about four feet in length. For constructing their cells and excavating these tubes, their fore feet are admirably adapted, being much larger and stronger than those for locomotion, and formed with stout claws like the craw fish, as here represented enlarged. Fig. 1.

Each pupa is armed with a stout proboscis, one fourth of an inch long, which usually lies between the fore legs on a line with the body. A remarkable example of instinct was observed in some which came to the surface under a pile of boards, raised by timbers five or six inches above the earth. The ground was wet, and to enable themselves to reach the dry boards they continued their cylinders up to them, forming thus towers of damp clay in the centre of which they were concealed. These towers were five or six inches high and about an inch in diameter; they were constructed of lumps of wet earth compacted together in a firm but rough manner. A diminished drawing of one of these is given in the annexed figure. A large number of these towers was found when the boards were removed; some had the top closed, and from these the Cicada had not departed. When they had reached the boards, they crawled along on the under side, and came to the open air, where, fixing on a spot favorable to their purpose, they remained attached, until a rupture was made in the cuticle on the back of the thorax, and the perfect insects then with great effort extricated themselves from the armour that had so long protected them in the earth. As there was no further use for the stout claws of the fore legs after they became denizens of the air, these legs were replaced by two that were small and delicate like the other four. In a few days after leaving the earth they had chosen their mates, and the female soon commenced depositing her eggs in the under sides of the tender branches of trees, by means of an ovi-positor, resembling an awl or punch, and continued at this for several days. The preceding year's growth of the branches of apple trees is a favorite wood with them;—but in the forest, the tender branches of almost any variety of

Fig. 2.

wood is used for this purpose. In a few days the leaves on the twig dry up, and the punctured part, in many instances, break with the wind and fall to the ground.

By the 21st of May they had increased rapidly, and the woods on the side hills were vocal with their music. The male is the songster and has vibrating air cells, back of and under the wings, as figured and described in Vol. xviii, p. 47, of this Journal. Where they are abundant their noise is deafening in the sunny and hot portion of the day, but they are nearly silent at night. About the sixth and seventh of June the weather was quite cold, which retarded their progress very much, and during a long and continued rain many of them died. They delight in heat and sunshine; moving about with great briskness. By the last of June they had nearly all perished; and as in 1829, numbers were seen flying short distances, after the abdomen had wasted away, and separated from the wings and thorax. By the middle of August, or about sixty days after the eggs are deposited, they are hatched, and the young Cicadas are ready to enter into the earth. They prevailed over the woody region on the north of the Ohio river, from the Alleghany mountains to the Mississippi; and were full as numerous as in 1829, but will probably diminish as the forests are cut away.*

Marietta, January 5th, 1847.

In continuation of this subject, which is one of general interest, we cite the following paragraphs from the very valuable work of T. W. Harris, M. D., on the Insects of Massachusetts injurious to Vegetation, (pp. 171–175,) referring to the work itself for a more complete history of the Cicada.†—*Eds.*

In those parts of Massachusetts which are subject to the visitation of this Cicada, it may be seen in forests of oak about the middle of June. Here such immense numbers are sometimes congregated, as to bend and even break down the limbs of the trees by their weight, and the woods resound with the din of their discordant drums from morning to evening. After pairing, the females proceed to prepare a nest for the reception of their eggs. They select, for this purpose, branches of a moderate size, which they clasp on both sides with their legs, and then bending down the piercer at an angle of about forty-five degrees, they repeatedly thrust it obliquely into the bark and wood in the direction of the fibres, at the same time putting in motion the lateral saws; in this way they detach little splinters of the wood at one end, so as to form a kind of fibrous lid or cover to the perforation.

---

* For figures of the perfect Cicada, see Vol. xviii, p. 47.

† Report on the Insects of Massachusetts, injurious to Vegetation; by Thaddeus William Harris, M. D. 460 pp., 8vo. Cambridge, 1841.

The hole is bored obliquely to the pith, and is gradually enlarged by a repetition of the same operation, till a longitudinal fissure is formed of sufficient extent to receive from ten to twenty eggs. The side-pieces of the piercer serve as a groove to convey the eggs into the nest, where they are deposited in pairs, side by side, but separated from each other by a portion of woody fibre, and they are implanted into the limb somewhat obliquely, so that one end points upwards. When two eggs have been thus placed, the insect withdraws the piercer for a moment, and then inserts it again and drops two more eggs in a line with the first, and repeats the operation till she has filled the fissure from one end to the other, upon which, she removes to a little distance, and begins to make another nest to contain two more rows of eggs. She is about fifteen minutes in preparing a single nest and filling it with eggs; but it is not unusual for her to make fifteen or twenty fissures in the same limb; and one observer counted fifty nests extending along in a line, each containing fifteen or twenty eggs in two rows, and all of them apparently the work of one insect. After one limb is thus sufficiently stocked, the Cicada goes to another, and passes from limb to limb and from tree to tree, till her store, which consists of four or five hundred eggs, is exhausted. At length she becomes so weak by her incessant labors to provide for a succession of her kind, as to falter and fall in attempting to fly, and soon dies.

Although the Cicadas abound most upon the oak, they resort occasionally to other forest trees and even to shrubs, when impelled by the necessity for depositing their eggs, and not unfrequently commit them to fruit trees, when the latter are in their vicinity. Indeed there seem to be no trees or shrubs that are exempted from their attacks, except those of the pine and fir tribes, and of these even the white cedar is sometimes invaded by them. The punctured limbs languish and die soon after the eggs which were placed in them are hatched; they are broken by the winds or by their own weight, and either remain hanging by the bark alone, or fall with their withered foliage to the ground. In this way orchards have suffered severely in consequence of the injurious punctures of these insects.

The eggs are one twelfth of an inch long, and one sixteenth of an inch through the middle, but taper at each end to an obtuse point, and are of a pearl-white color. The shell is so thin and delicate that the form of the included insect can be seen before the egg is hatched, which occurs, according to Dr. Potter, in fifty-two days after it is laid, but other persons say in fourteen days.

The young insect when it bursts the shell is one sixteenth of an inch long, and is of a yellowish white color, except the eyes and the claws of the fore-legs, which are reddish; and it is covered with little hairs. In form it is somewhat grub-like, being

longer in proportion than the parent insect, and is furnished with six legs, the first pair of which are very large, shaped almost like lobster-claws, and armed with strong spines beneath. On the shoulders are little prominences in the place of wings; and under the breast is a long beak for suction. These little creatures when liberated from the shell are very lively, and their movements are nearly as quick as those of ants. After a few moments their instincts prompt them to get to the ground, but in order to reach it they do not descend the body of the tree, neither do they cast off themselves precipitately; but running to the side of the limb, they deliberately loosen their hold, and fall to the earth. It seems, then, that they are not borne to the ground in the egg state by the limbs in which their nests are contained, but spontaneously make the perilous descent, immediately after they are hatched, without any clue, like that of the canker-worm, to carry them in safety through the air and break the force of their fall. The instinct which impels them thus fearlessly to precipitate themselves from the trees, from heights of which they can have formed no conception, without any experience or knowledge of the result of their adventurous leap, is still more remarkable than that which carries the gosling to the water as soon as it is hatched. In those actions that are the result of foresight, of memory, or of experience, animals are controlled by their own reason, as in those to which they are led by the use of their ordinary senses or by the indulgence of their common appetites they may be said to be governed by the laws of their organization; but in such as arise from special and extraordinary instincts, we see the most striking proofs of that creative wisdom which has implanted in them an unerring guide, where reason, the senses and the appetites would fail to direct them. The manner of the young Cicadas' descent, so different from that of other insects, and seeming to require a special instinct to this end, would be considered incredible perhaps, if it had not been ascertained and repeatedly confirmed by persons who have witnessed the proceeding. On reaching the ground the insects immediately bury themselves in the soil, burrowing by means of their broad and strong fore-feet, which, like those of the mole, are admirably adapted for digging. In their descent into the earth they seem to follow the roots of plants, and are subsequently found attached to those which are most tender and succulent, perforating them with their beaks, and thus imbibing the vegetable juices which constitute their sole nourishment.

They do not appear ordinarily to descend very deeply into the ground, but remain where roots are most abundant; and it is probable that the accounts of their having been discovered ten or twelve feet from the top of the ground have been founded on some mistake, or the occurrence of the insects at such a depth may have been the result of accident. The only alteration to

which the insects are subject, during the long period of their subterranean confinement, is an increase of size, and the more complete development of the four small scale-like prominences on their backs, which represent and actually contain their future wings.

As the time of their transformation approaches, they gradually ascend towards the surface, making in their progress cylindrical passages, oftentimes very circuitous, and seldom exactly perpendicular, the sides of which, according to Dr. Potter, are firmly cemented and varnished so as to be water-proof. These burrows are about five-eighths of an inch in diameter, are filled below with earthy matter removed by the insect in its progress, and can be traced by the color and compactness of their contents to the depth of from one to two feet, according to the nature of the soil; but the upper portion to the extent of six or eight inches is empty, and serves as a habitation for the insect till the period for its exit arrives. Here it remains during several days, ascending to the top of the hole in fine weather for the benefit of the warmth and the air, and occasionally peeping forth apparently to reconnoitre, but descending again on the occurrence of cold or wet weather.

During their temporary residence in these burrows near the surface, the Cicada grubs, or more properly pupæ, (for such they are to be considered at this period, though they still retain something of a grub-like form,) acquire strength for further efforts by exposure to the light and air, and seem then to wait for only a favorable moment to issue from their subterranean retreats. When at length this arrives, they issue from the ground in great numbers in the night, crawl up the trunks of trees, or upon any other object in their vicinity to which they can fasten themselves securely by their claws. After having rested awhile they prepare to cast off their skins, which, in the mean time, have become dry and of an amber color. By repeated exertions a longitudinal rent is made in the skin of the back, and through this the included Cicada pushes its head and body, and withdraws its wings and limbs from their separate cases, and, crawling to a little distance, it leaves its empty pupa-skin, apparently entire, still fastened to the tree. At first the wing-covers and wings are very small and opake, but, being perfectly soft and flexible, they soon stretch out to their full dimensions, and in the course of a few hours the superfluous moisture of the body evaporates, and the insect becomes strong enough to fly.

During several successive nights the pupæ continue to issue from the earth; above fifteen hundred have been found to arise beneath a single apple tree, and in some places the whole surface of the soil, by their successive operations, has appeared as full of holes as a honeycomb. In Alabama the species under consideration leaves the ground in February and March, in Maryland and Pennsylvania in May, but in Massachusetts it does not come forth

till near the middle of June. Within about a fortnight after their final transformation they begin to lay their eggs, and in the space of six weeks the whole generation becomes extinct.

Fortunately these insects are appointed to return only at periods so distant that vegetation often has time to recover from the injury they inflict; were they to appear at shorter intervals, our forest and fruit trees would soon be entirely destroyed by their ravages. They are moreover subject to many accidents, and have many enemies, which contribute to diminish their numbers. Their eggs are eaten by birds; the young, when they first issue from the shell, are preyed upon by ants, which mount the trees to feed upon them, or destroy them when they are about to enter the ground. Blackbirds eat them when turned up by the plough in fields. Hogs are also excessively fond of them, and, when suffered to go at large in the woods, root them up, and devour immense numbers just before the arrival of the period of their final transformation, when they are lodged immediately under the surface of the soil. It is stated that many perish in the egg state, by the rapid growth of the bark and wood, which closes the perforations and buries the eggs before they have hatched; and many, without doubt, are killed by their perilous descent from the trees.

ART. XXV.—*On the Analysis of the Oat;* by Prof. JOHN PITKIN NORTON,* of Yale College.

A CHEMICAL inquiry into the nature of the oat would be of importance in almost any part of Europe, but it becomes a kind of national object in a country where, as in Scotland, oatmeal forms almost the sole food of a large portion of the population. But though Scotchmen have long fed and thriven upon it, and have carried their estimation of its virtues to every quarter of the globe where their adventurous footsteps have penetrated, the true properties of the oat, its chemical constituents, and the physiology of its growth, have been almost unnoticed. The few investigations hitherto published have been of a partial character. Hermbstädt and Sprengel were among the first who made experiments on the subject at all worthy of confidence. More lately Boussingault has published a single analysis; but no researches of an extended nature have hitherto been published.

To the Highland and Agricultural Society belongs the honor of first encouraging an extended inquiry for the purpose of increasing our knowledge as to the general value of the oat, as food for man and beast, and as to other points, physiological and

* This memoir, here reprinted, was presented by its author to the Highland Agricultural Society of Scotland, and received the premium of fifty sovereigns. The investigations were made in 1845.

practical, connected with its growth and cultivation. The encouragement of such researches is well calculated to retain for the Society its high position, and if possible, to increase the estimation in which it is held, as the parent of the Agricultural Societies in the British Islands.

In the laboratory of the Agricultural Chemistry Association, I have enjoyed great advantages for the prosecution of such an investigation. The kindness of Professor Johnston afforded me every facility, while his great experience pointed out the proper method for the prosecution of my inquiries.

In the detail of my results I have endeavored so to arrange them as to present a distinct connected view of the whole investigation, such as is necessary for its full appreciation. I have commenced with that which naturally comes first, the young plant, and have followed it through its successive stages of growth and development to maturity. This part of the subject completed, I proceed to the consideration of the full-grown plant.

I. Of the Unripe Plant.

Through the kindness of my friend Mr. J. Girdwood of Featherhall, Corstorphine, I was enabled to obtain during the past season, at intervals of a week, specimens of the young corn, cut always from the same spot in the field, and forwarded so as to reach me in a perfectly fresh condition.

I must here express my very great obligations to Mr. Fromberg, first assistant in the Laboratory of the Agricultural Chemistry Association, to whom I am indebted for nearly all the results connected with the unripe plant. Early last spring, he undertook this part of the investigation, at the request of Professor Johnston, and has devoted much of his time to it during the past season. I am thus enabled to render my paper far more complete than it could otherwise have been.

A. *Of the Quantity of Ash yielded by the several parts of the Unripe Plant.*

As soon as the plants were received, portions of the several parts were weighed for the purpose of determining the water, and dried at a temperature not exceeding 212° Fahrenheit, until their weight became constant. At least three separate portions of each part were taken to provide for accidents, and to secure at least two concurring determinations.

While the above were drying, others were weighed from which to determine the ash. The burning was always effected in platinum vessels over argand gas-burners, and at a dull red heat.

The first specimens of the young plant arrived on the 4th of June, and the succession at weekly intervals was uninterrupted until the cutting of the crop on the 3d of September. The oats

were of the potato variety, and though retarded by the unusually wet season, were uniformly strong and healthy, the sample proving one of uncommon excellence. The plants on the 4th of June were from four to six inches in height, consisting merely of one leaf, and the commencement of the stalk. These two parts, therefore, are first to be considered, as to the quantity of ash which they yield.

1. *Of the Leaf.*—The following Table exhibits the proportions in the leaf at successive stages of its growth—1. Of Water. 2. Of Ash. 3. Of Ash calculated dry.

TABLE I.

	June				July					August				Sept.
	4.	11.	18.	25.	2.	9.	16.	23.	30.	6.	13.	20.	27.	3.
Per cent. of Water,	80·51	82·76	82·01	78·53	80·26	76·97	76·53	77·61	77·00	76·63	74·06	79·93	70·68	24·60
Per cent. of Ash,	2·16	1·86	1·63	2·35	2·24	2·81	3·06	3·55	3·78	3·75	6·14	4·25	6·49	15·78
Do. calculated dry,	10·83	10·79	9·07	10·95	11·35	12·20	12·61	16·45	16·44	16·05	10·47	21·14	22·13	20·90

During the whole growth of the plant the diminution in the quantity of water in the leaf was not great, being only about 10 per cent. from the 4th of June to the 27th of August. So late as the 20th of August it was nearly as high as at first. When the plant becomes ripe, however, the leaf at once withers, and this accounts for the great decrease of water between the 27th of August and the 3d of September. This decrease in the water gives a great apparent increase of ash in the undried leaf. When calculated dry, in the third line, there appears an actual decrease from the two preceding weeks. There may have been some change in the circulation at the last, by which a portion of the inorganic materials was carried back into the stalk.

2. *Of the Stalk.*—The per-centages of water, of ash, and of ash calculated dry, were determined as in the leaf.

TABLE II.

	June				July					August				Sept.
	4.	11.	18.	25.	2.	9.	16.	23.	30.	6.	13.	20.	27.	3.
Per cent. of Water.	87·04	87·05	87·13	84·74	83·66	82·05	80·85	79·60	76·64	75·66	69·80	76·27	71·57	71·70
Per cent. of Ash,	1·36	1·28	1·28	1·40	1·28	1·40	1·52	1·63	1·74	2·01	2·00	1·58	2·19	2·36
Do. calculated dry.	10·49	9·88	9·32	9·17	7·83	7·80	7·94	7·99	7·45	7·63	6·62	6·66	7·71	8·35

The decrease of water during the growth of this part is considerably more than in the leaf. The quantity of ash in the undried straw (second line) increases toward the end, as in the undried leaf. This, in both cases, is owing to the gradual disappearance of the water; for we see, in the third line, that the actual per-centage of ash in the *dried* stalk is less on the 3d of September than it was on the 4th of June. In the earlier growth of the stalk, the dried stem or solid part, though less in quantity, actually contains a larger per-centage of ash than is afterwards necessary to its perfect maturity. As the stalk is the stem of the plant, through it must pass the inorganic materials necessary for the building up of all the other parts. How wise the provision,

which enables it to furnish an abundance of these materials at the time when they are most needed! Between the 6th and the 27th of August, the demand upon the straw was very great; at this period the grain was most rapidly attaining its full size; the leaf also between the 13th and the 20th of August, increased its per-centage of ash from 16 to 21. When these parts have attained their full size, and approach maturity, the ash in the stalk begins to accumulate again, as is seen in the last two weeks. This is at the same time that the decrease in the leaf, mentioned above, takes place.

From the very large per-centage of water in the stalk on the 3d of September, when the oats were cut, it is evident that there must be an immense diminution during the drying of harvest, as I have seldom found more than 13 or 14 per cent. of water in straw taken from a well-made stack. This will appear in a subsequent table.

3. *Of the Quantity of Ash in the Knots.*—It was not until the 23d of July that determinations of ash and water in the knots were commenced. Professor Johnston has stated in his Elements of Agricultural Chemistry, some curious facts respecting the knots in the stalks of wheat, rye, bamboo, &c. He says, that the ash of this part is larger in quantity, and contains a greater proportion of silica, which, in the bamboo, is sometimes found in solid masses. To ascertain if the quantity of ash in the knots of oats varied greatly from that in the whole straw, these trials were made.

Table III.

	July 23.	July 30.	Aug. 6.	Aug. 13.	Aug. 20.	Aug. 27.	Sept. 3.
Per cent. of Water, . .	76·05	75·54	74·82	75·29	75·38	73·55	70·65
Per cent. of Ash, . . .	2·40	2·54	2·63	2·80	2·90	2·98	3·14
Do. calculated dry, . .	10·02	9·60	10·44	10·48	11·79	11·27	10·7

The variation in the per-centage of water in this table is not large. The ash is, in accordance with Professor Johnston's results, larger in quantity than in the straw, taken as a whole. The difference in the ripe plant amounts to 2 per cent. But in Table II, the ash is given for the *whole straw*, including the knots; the difference therefore between the knots and the straw, taken separately, would be at least 4 per cent. The variations in the per-centage of ash, shown by the above table, are not very striking.

4. *Of the Quantity of Ash in the Chaff.*—The determinations of ash and water in this part of the plant commenced on the 16th of July. I must here mention, that by the chaff I mean the outer covering which envelopes the oat during its growth, becoming looser as it ripens, and finally falling off during thrashing.

Per-centage of ash and water exhibited as before.

TABLE IV.

	July 16.	July 23.	July 30.	Aug. 6.	Aug. 13.	Aug. 20.	Aug. 27.	Sept. 3.
Per cent. of Water,	55·01	56·95	50·49	45·04	40·86	47·08	40·44	21·96
Per cent. of Ash,	2·72	3·92	6·08	7·83	11·05	11·20	13·38	21·43
Do. calculated dry,	6·00	9·11	12·28	13·75	18·68	21·07	22·46	27·47

The quantity of water given by the above table is much less, while that of ash is much greater, than in any other part of the unripe plant. The extraordinary quantity of 27 per cent., as given in the third line, is very remarkable. It is to be observed, however, that in no other specimen of chaff have I found so high a per-centage. The crop, as I have before stated, was unusually vigorous, and grown on a deep rich loam, where every thing it required seems to have been in abundance, and the per-centage of ash in every part is uncommonly large. It will be noticed that the increase of ash is more steadily progressive than in any of the other parts.

5. *Of the Quantity of Ash in the Oat.*—It is necessary for me here to explain, that, in speaking of the *Oat*, I always mean the seed and husk together. By the *Grain*, I mean the seed divested of its husk. This distinction will prevent confusion. The oats did not become sufficiently developed for separation from the stalk until the 2d of July. The same treatment was pursued as with the other parts, and the following table exhibits the results.

TABLE V.

	July 2.	July 9.	July 16.	July 23.	July 30.	Aug 6.	Aug 13.	Aug. 20.	Aug. 27.	Sept. 3.
Per cent. of Water, . .	89·84	75·56	69·83	63·22	62·06	62·44	55·11	49·76	45·98	30·74
Per cent. of Ash, . . .	0·94	1·02	1·17	1·33	1·60	1·62	1·87	1·83	1·90	2·53
Do. calculated dry, . .	4·91	4·36	3·38	3·62	4·22	4·31	4·07	3·64	3·51	3·65

During the growth of this part of the plant, the per-centage of water steadily decreased to considerably less than one-half of the original quantity. As in the stalk, this has caused an apparent increase of ash (second line), but when calculated dry (third line), there is an actual decrease. This diminution of ash occurs only in these two parts of the plant. I have already given a probable explanation of the cause in the stalk, and think that one equally simple may be given as to the oat itself. Every one who has noticed its growth, knows that the husk, being necessary for the protection of the grain, is formed first, and attains nearly its full size while the grain is yet scarcely visible. A subsequent table will show that the husk contains about three times as much ash as the grain. During the first growth of the oat, this husk, requiring an abundance of inorganic materials, is to be formed, and we accordingly find such a proportion of these materials present, as are not found at any subsequent period. When the husk is formed the grain enlarges, and as it gradually becomes three-

fourths of the oat, the per-centage of ash, taking the two together, of course diminishes. By reference to Table II, it will be seen, that on the 2d of July, just when the oat began to show itself, a sudden decrease took place in the ash of the stalk. The per-centage of water in the oats when the crop was cut, on the 3d of September, was more than twice as much as I have found in those taken from the granary or stack-yard.

Heretofore I have only spoken of the quantity of ash yielded by the several parts of the plant; I now would direct attention to the composition of this ash, which will constitute the second division.

B. *Of the Quality of the Ash from the several parts above mentioned.*

This series of analysis by Mr. Fromberg, has already involved a very great amount of labor, and is not yet by any means finished, extending only over seven weeks of the fourteen, in which the determinations of the quantity of ash were made. They extend to the 16th of July; and, so far as they go, present a complete view of the curious and interesting changes which take place during the development of the various parts of the plant. As before, I will place the leaf first.

1. *Composition of Ash from the Leaf of Unripe Oats at different periods of growth.*

TABLE VI.

	June 4.	June 11.	June 18	June 25.	July 2.	July 9.	July 16
Potash and soda, . .	24·60	23·51	26·21	28·10	18·78	16·09	18·35
Chlorid of sodium, .	16.34	13·54	11·30	7·56	7·92	4·09	0·30
Lime, ...	8.44	7·24	7·33	6·74	6·91	5·93	5·13
Magnesia, ...	5.33	3·11	3·47	3·06	2·39	2·35	1·63
Oxyd of iron, . . .	0.61	0·52	0·72	0·99	0·40	0·34	0·55
Sulphuric acid, . . .	11.74	12·85	10·59	7·88	9·50	6·45	13·05
Phosphoric acid, . .	16.16	10·57	10·12	8·76	6·92	6·44	2·91
Silica, ...	16.58	28·54	30·31	36·50	47·62	58·28	58·22
	99·80	99·88	100·05	99·59	100·14	99·97	100.14

Perhaps the most striking feature in this table is the gradual disappearance of the chlorid of sodium (common salt); from 16 per cent., in seven weeks it decreased to less than a third of a per cent. A large quantity of soda yet remains, nearly all, no doubt, in the state of sulphate. The phosphoric acid, too, disappears in a great degree. There were at first probably phosphates of potash and soda, but these must have left the leaf to supply the grain, and on the 16th of July the small quantity of phosphoric acid left was nearly all in combination with lime, magnesia, and iron. The oxyd of iron seems to have fluctuated in its proportions less than any of the other substances.

2. *Of the Composition of Ash from the Stalks of the Unripe Plant.*

TABLE VII.

	June 4.	June 11.	June 18	June 25.	July 2.	July 9	July 16.
Potash and soda, . .	24·94	21·45	26·49	28·86	36·26	30·10	42·43
Chlorid of sodium, .	32·66	34·65	24·94	24·57	11·62	17·82	4·46
Lime, ...	2·40	4·22	3·74	2·42	2·64	1·69	4·12
Magnesia, ...	0·88	3·20	2·20	2·58	1·17	2·27	1·47
Oxyd of iron, . . .	0·39	0·30	0·40	0·58	0·88	0·68	0·62
Sulphuric acid, . .	6·15	7·82	8·51	4·87	7·98	9·09	7·84
Phosphoric acid, . .	16·15	13·96	12·55	7·81	2·21	5·57	6·31
Silica, ...	16·29	14·32	20·41	28·08	36·64	32·39	34·85
	99·86	99·92	99·24	99·77	99·40	99·52	100·33

The decrease in the quantity of chlorid of sodium is here also very remarkable, from 32½ to 4½ per cent. The phosphoric acid continued without much variation until the 25th of June, when the oat itself began to form; by the 2d of July the oats had shot up from the stalk and become visible; in that week a marked and sudden decrease took place in the phosphoric acid. In the two succeeding weeks it began again to increase. No very great changes seem to have taken place in the other constituents, excepting the gradual increase of silica. The composition of the stalk on the 16th of July differs very greatly from that of a mature stalk, as will afterwards be seen. It was then still green and vigorous, growing rapidly, and serving as a canal for the conveyance of a great portion of their food to the other parts of the plant. The inorganic ingredients, therefore, might be expected to vary, as we see them, with the fluctuations of temperature more or less favorable to vegetable growth.

3. *Composition of Ash from the whole Oat, at different periods of its growth.*

TABLE VIII.

	July 2.	July 9.	July 16.
Potash and soda, ...	32·92	31·31	31 37
Chlorid of sodium, ...	10·37	8·10	0·61
Lime, ...	2·70	5·40	6·76
Magnesia, ...	3·44	4·72	2·94
Oxyd of iron, ...	0·39	0·21	0·35
Sulphuric acid, ...	10·35	12·78	16·42
Phosphoric acid, ...	14·02	20·69	15 19
Silica, ...	24·40	17·05	26·05
	98·59	99·46	99·69

During these three weeks the oat attained nearly its full length, but was yet quite green, and the grain had scarcely begun to form in the interior of the husk. The above table, therefore, only enables us to compare the earliest part of its growth with the latest as afterwards given. The diminution of chlorine is, however, to be noticed as very great in the short space of three weeks. I think the large quantity of sulphuric acid present at this time would have diminished, as I have seldom found so much in the ash of the ripe oat.

4. *Comparative View of the Composition of the Ash from the Leaf, Stalk, Oat, Knots, and Chaff, on the 16th of July.*

TABLE IX.

	Leaf.	Stalk.	Knots.	Chaff.	Oat.
Potash and soda, . .	18·35	42·43	39·21	15·39	31·37
Chlorid of sodium, .	0·30	4·46	0·60	2·01	0·61
Lime, ...	5·13	4·12	4·75	4·58	6·76
Magnesia, . . .	1·63	1·47	4·51	3·10	2·94
Oxyd of iron, . .	0·55	0·62	1·02	1·50	0 35
Sulphuric acid, . .	13·05	7 84	27·94	9·90	16 42
Phosphoric acid, . .	2·91	6 31	9·03	7 26	15·19
Silica, ...	68·22	34 85	13·23	56 38	26·05
	100·14	100·33	100·29	100·12	99·69

On the 16th of July the plant was in the midst of its most rapid growth, and just half-way between the time when it appeared above ground in June, and when it was cut on the 3d of September. In a subsequent table will be found a comparison of the ash from these parts of the plant when fully matured.

5. *Organic Constituents of the Unripe Plant.*—In connexion with the first chapter of my subject, I have hitherto said nothing of the organic constituents of the unripe plant. Mr. Fromberg has determined the nitrogen in the unripe oat at six periods of its growth, and also when it had become fully ripe. The following table gives his results.

TABLE X.

	July 16.	July 30	Aug. 13.	Aug. 20.	Aug. 27.	Sept. 3.	Quite ripe.
Per centage of nitrogen in undried oat,	0·51	0 51	0·62	0·66	0·97	1·52	1·87
Do. do. in dried oat, . . .	1·71	1 35	1·38	1·31	1·79	2·20	2·18
Do. do. of protein compounds in undried oat, ...	3.24	3·24	3·90	4·15	6·10	9·58	11·80
Do. of do. in dried oat, . .	10·75	8·50	8·69	8·27	11·26	13 84	13·72

The steady increase of nitrogen from the 30th of July is very striking. Had time permitted, it would have been of much interest to determine the other organic constituents, both proximate and ultimate. This tempting field we have been obliged to leave for future exploration. I now pass on to that part of the investigation upon which I have, myself, been principally engaged.

II. OF THE RIPE PLANT.

It now remains to consider the plant in a state of maturity, both as to its inorganic and its organic constituents. To the inorganic part I shall first direct attention, and here, as in the first chapter, I shall take up different portions of the plant in succession.

1. *Of the Ash yielded by the Straw.*—It has been shown by Professor Johnston,* that the ash from the straw of all the corn

* See his *Elements*, p. 44.

crops varies in quantity at different heights of the same stalk. To ascertain the nature and extent of this variation in the oat straw I considered a point of importance, and to it I first directed my attention. Each straw was divided into three equal parts, the bottom, the middle, and the top. These were separately burned in the same manner, and with the same precautions as have already been described under the unripe plant, each burning being repeated until two or more trials were found to agree.*

The following table gives a comparative view of the per-centage of ash in these three parts, from five different samples of straw of the localities stated over each column. The ash is calculated dry, and the average per-centage of water given in the upper line.

TABLE XI.

	Hopeton, Hexham, Northumberland.	Hopeton, Kilwhiss, Fife.	Dun, Swanston, Edinburgh.	Potato, Hexham, Northumberland.	Sandy, Kilwhiss, Fife.
Average of water, . .	11·21	10·11	9·36	10·99	9·19
Per cent. of ash in top straw,	4·95	5·44	8·25	9·23	10·01
Do. do. in middle straw,	6·11	4·23	6·53	7·41	9·01
Do. do. in bottom straw,	5·33	5·86	7·19	9·76	7·30

The above table establishes two facts: 1. That there is a great difference in the quantity of ash yielded by the same straw at different heights. 2. That the ash yielded by the same part varies greatly in different specimens; and that this holds true even when the samples are of the same variety of oat, as is seen in the Hopeton oats above. Thus far the results of Professor Johnston are confirmed. There is not, however, a regular gradation in the quantity of ash, from the top downwards. In only one case, that of the Sandy oats, is this gradation to be observed. It may be that, if I had taken but one straw at a time, and accurately divided it, the result would have been different. I am inclined to doubt this, however; for the straw of the oat crop is well known to be more irregular in quantity than that of any other corn crop: and table twelve shows that the average quantity of its ash is equally variable: this variation may very probably extend to different parts of the same stalk. Even if the averages of the above parts are taken, we still find a great difference in the amount of ash.

* The straw of the ripe oat generally burns with difficulty, if the heat be too great it fuses, enveloping in a kind of glass some of the carbonaceous matter; it is then almost impossible to burn it white. I have often been obliged to burn samples for more than twenty-four hours. The addition of peroxyd of mercury has been proposed, and would undoubtedly be effective in whitening the ash, but I have feared that it would decompose some of the chlorides, and have therefore not made use of it.

The following table illustrates this.

Average per-centage of Ash in Six Samples of Oat Straw.

TABLE XII.

	No. 1, Hopeton.	No. 2, Hopeton.	No. 3, Dun.	No. 4, Sandy.	No. 5, Potato.	No. 6, Potato.
Average per cent. of ash.	5·46	5·02	7·29	9·11	8.76	8·65

We see here a range of a little more than 4 from the lowest to the highest per-centage. If there were 3000 lbs. of straw upon an acre, the difference between the weights of inorganic matter carried off by the two crops, Nos. 2 and 5, would amount to about 128 lbs. per acre. Though they do not exactly agree, yet there is a much nearer approach to agreement in the two samples of Hopeton oats, and in the two samples of Potato oats, seeming to indicate that the average quantities of ash are more nearly alike in the same variety. This is very singular if true, but needs further proof. If the average of the above six trials can be considered as a standard, the usual per-centage of ash in oat straw is about 7·50.

The foregoing points as to the quantity of ash, being, as I hope, now sufficiently distinct, I come to an inquiry of much importance; do these differences in the quantity extend to the quality of the ash also? I shall proceed to show—1. That the ash varies in quality at different heights of the same stalk. Dividing the straw into three parts as above, and analyzing the ash from each part separately, the results are as follows.*

* It is proper here to introduce a brief account of the method which I have followed in the analyses of these ashes.

I have always divided them into three portions. 1. That which was soluble in water; 2. That which was soluble in acid; 3. That which remained insoluble. It is not necessary here to enter upon a detail of the reasons for this division; suffice it to say, that it was made as being likely to throw light upon various physiological questions, connected with the mode of growth and the circulation of the plant. Each division was subject to analyses separately.

1. *The watery solution.*—This was first evaporated to dryness, heated to drive off organic matter, and weighed. To the dry mass water was then added, and a small portion always refused to re-dissolve. This was, in several instances, analyzed, and found to be chiefly soluble silica. In my later analyses this was added to the acid solution, to save time.

To the re-dissolved part of the watery solution—

1. Nitrate of silver was added to throw down the chlorine, the liquid being previously acidulated by nitric acid. The precipitate was collected, burned and weighed, with the usual precautions.

2. The excess of silver having been thrown down by hydrochloric acid, and removed by filtration, nitrate of baryta was added to obtain the sulphuric acid. This precipitate was allowed to stand at least twelve hours before filtration.

3. After removing the excess of baryta from the solution by sulphuric acid, hydrosulphuret of ammonia was added, to throw down the manganese.

The phosphoric acid was determined by the method of Berthier, well known to analytical chemists—an excellent method when the usual precautions are employed, and there is no iron in the solution.

4. The solution was next evaporated to dryness, and the sulphate of potash and soda weighed together, then re-dissolved, and the potash obtained by the bi-chlorid of platinum. The precipitate, collected and weighed in the usual manner, was

Composition of Ash from Oat Straw at three different heights. Hopeton Oat from Mr. Harbottle, Hexham, Northumberland.

TABLE XIII.

	Top Straw.	Middle Straw.	Bottom Straw.
Sulphuric acid,	38·55	18·45	16·10
Chlorid of sodium, (common salt,)		3·03	15·36
Potash and soda,		21·80	40·17
Phosphates of lime, magnesia and iron,	2·84	3·03	0·78
Lime,	7·02	7·23	6·06
Magnesia,	2·84	2·91	2·07
Oxyd of iron,	0·30	1·40	0·61
Soluble silica,	5·13	7·34	5·03
Insoluble silica,	43·31	33·14	12·29
	99·99	98·33	98·47

In reference to the above analyses, I wish to direct attention to several points.

1. To the great difference in the proportion of salts soluble in water. Part of these are grouped together in the top straw analyses; with the addition of the soluble silica, their amount is 42 per

---

calculated as sulphate; this, subtracted from the united weight of the sulphates as weighed above, gave the loss as sulphate of soda, from which the soda was calculated.

II. *The acid solution.*—1. Ammonia was added to throw down the phosphates. The precipitate was always a mixture of phosphates of lime, magnesia and iron. It was fused with carbonate of soda, the phosphoric acid determined by Berthier's method, and the lime, magnesia, &c., in the usual way. This method of analyzing phosphates is by no means a perfect one, but with certain precautions very good results may be obtained. I have tried various other methods with bad success. One of these has been highly recommended; it is that of throwing down the phosphoric acid as a phosphate of the peroxyd of iron, from a solution in acetic acid. The precipitate obtained is so variable in its composition, that it is always necessary to analyze it separately, and the whole process is so uncertain, that after many trials I abandoned it.

2. The lime was thrown down by oxalate of ammonia, and collected after standing at least twelve hours.

3. As I found, in almost every instance, potash and soda in this part of the acid solution, it became necessary to determine the magnesia in some other than the usual way, by phosphate of soda. The solution was therefore evaporated nearly to dryness, mixed with a little peroxyd of mercury, and rather strongly heated. The chlorids of potassium and sodium decompose with great difficulty, and that of magnesia with ease; the latter was therefore by heating converted into caustic magnesia, and separated by washing with *boiling* water. The solution, containing the potash and soda, was now evaporated to dryness, and they were determined as above.

III. *The insoluble portion.*—1. This was fused with five times its weight of carbonate of soda, the fused mass dissolved in hydrochloric acid, and the silica obtained in the usual way.

2. The phosphates were precipitated by ammonia, and, after weighing, were analyzed with the phosphates of the acid solution.

3. The lime was thrown down as usual by oxalate of ammonia, and the magnesia by phosphate of soda.

4. Potash and soda. A small quantity of potash and soda is often present even in the insoluble part of the ash, and I have, therefore, in many cases been obliged to determine it by fusing with baryta in the ordinary way.

The above is an outline of a complete analysis, according to the methods I have generally pursued, supposing all the substances mentioned to be present. Of course their presence or absence was previously ascertained by a qualitative examination, and the analysis modified accordingly. The quantity I considered proper for analysis was from 20 to 30 grains.

cent., in the middle straw it is 55 per cent., in the bottom straw 77 per cent. The increase of these soluble salts, therefore, is very great as we proceed downwards, the proportion being nearly twice as great at the bottom as at the top.

2. To the abundance of sulphuric acid and the total absence of phosphoric acid in the watery solution.

3. That as the salts soluble in water increase from the top downwards, the silica increases from the bottom upwards. This seems to be an invariable law. The *quantity* of ash, as I have shown, varies, being sometimes greater in one part and sometimes in another; but whichever part this may be, whether the top or the bottom has most *ash*, in *every* case that I have examined, the top has the most silica, and the bottom the most salts soluble in water.

Having thus shown that different parts of the same straw vary, I proceed to prove, in the second place, that the same parts vary in different straws. In order to make my results bear upon as many questions as possible, I have selected two samples of the same variety of oats grown on two widely different soils. No. 1, was from a light rather sandy loam, of good quality. No. 2, was from a poor mossy soil, where the great difficulty is to make the straw stand.

Table, giving the composition of Ash from Straw of two specimens of Hopeton Oats.

TABLE XIV.

	No. 1. Top Straw.	No. 2. Top Straw.	No. 1. Middle Straw.	No. 2. Middle Straw.	No. 1. Bottom Straw.	No. 2. Bottom Straw.
Salts soluble in water, chiefly sulphates and chlorids,	41·96	71·70	55·22	84·03	77·46	90·26
Phosphates of lime, magnesia and iron,	2·94	0·77	3·03	1·51	0·78	2·21
Lime and magnesia,	11·29	14·34	9·70	8·73	9·16	2·65
Silica,	43·75	13·18	32·05	5·72	12·55	4·86
	99·94	99·99	100·00	99·99	99·95	99·98

On comparison of the above analyses, it is first to be noticed, that there is an extraordinary difference in the per-centage of salts soluble in water, in each part of the two samples. The top straw and middle straw of No. 2, each contain about 30 per cent. more than the corresponding portions of No. 1.

2. That this difference is equally great as regards the silica.

3. That the lime and magnesia also in both instances are greatest in the top straw.

This table may be considered a very excellent illustration of the extent to which the soil modifies the composition of the ash. No. 1, is a fair example of a healthy straw. No. 2, being the same variety of oat, has been grown where its wants were not fully supplied. I have said that on the mossy soil from which

this sample came, the great difficulty was to make the straw stand. The above analysis shows that a want of silica was probably the cause of this difficulty. It is a curious fact in accordance with the above, that the addition of a very fine siliceous sand to some places on this soil has in a great degree remedied this weakness of straw. The abundance of alkalies present in the soil, judging from the quantity in the above ash, may facilitate the solution of this finely divided silica. The *quantity* of ash in the two samples does not greatly differ,—see Table VI. No. 2 seems to have endeavored to supply the want of silica by potash and soda. Sprengel has made an analysis of ash from oat straw; but his results differ much from mine. He gives for instance 80 per cent. of silica. Fifty per cent. is the largest quantity I have observed even in the top straw. The variations that I have found are, however, so great, that I hesitate to pronounce his analysis erroneous. Some peculiar circumstances may have caused the presence of even this extraordinary quantity.

Before leaving for the present the subject of the straw, I may mention, that I have, so far as my time permitted, turned my attention to the disease called the *smut* in oats, and have several analyses of ash from the smutted straw. I regret much that they are not in a sufficiently advanced state for publication. So far as they go, they indicate a derangement in the circulation of the plant, especially in the top straw.

The following comparison will show that in *quantity* the ash does not materially differ from that of the healthy straw.

TABLE XV.

	Top straw.	Middle straw.	Bottom straw.
Ash from healthy straw, ...	5·64	7·89	9·17
Ash from smutted straw, ...	6·52	6·10	7·78

2. *Of the ash yielded by the leaf.*—This part of the plant, though it withers away, and seems of little consequence when the corn is ripe, is yet of vital importance during its growth, and therefore demands our attentive consideration.

It yields more ash than the straw, in some cases fully twice as much; and this ash, like that of the straw, varies in quantity with the soil, the manure, and the variety of oat.

The following table gives the per-centage of ash and of water, in six samples of leaf. The ash, as usual, is calculated dry.

TABLE XVI.

	Hopeton Oats.		Dun	Sandy	Potato Oats.		Mean of
	No. 1.	No. 2.	Oats.	Oats.	No. 1.	No. 2.	trials.
Of Water, ...	9·08	9·57	10·11	10·95	10·33	11·02	10·14
Of Ash, ...	7·19	8·44	10·29	14·79	14·59	20·90	12·70

In this table the differences are much greater than those which appeared in the straw. The leaf from the potato oat No. 2, has

nearly three times the per-centage of ash yielded by that from the Hopeton oat No. 1. The potato oat leaf came from an extraordinary crop on a rich loam; the Hopeton oat leaf from a very inferior straw on a poor soil.

In separating the leaf from the stalk, I took the whole leaf from the knot to which the bottom is attached, thus including the part which wraps around the stalk.

It occurred to me that there might be a difference in the quantity of ash yielded by this latter part, compared with that portion of the leaf which projects from the stalk. I accordingly separated the leaf of a Sandy oat into two parts, and separately determined the ash with the following result.

TABLE XVII.

	Ash calculated dry.
Ash from top of the leaf,	16·22
do. from bottom,	13·66

This difference in the quantity of these two ashes, is what we should have been led to expect from the previous determinations of ash in the straw, where it was in a majority of cases most abundant at the top.

There are fewer disturbing causes in the circulation of the leaf than in that of the straw, and we may perhaps rely with more certainty on a regular gradation of ash from the top to the bottom.

The quality of the ash from the leaf differs from that of the straw. The following extended analysis is of the ash from what may be considered a fair specimen of a healthy leaf, neither excessively luxuriant, nor at all stinted in its growth. It is from the same Hopeton oat of which the straw ash analyses were given in Table XIII.

Composition of Ash from the Leaf of Hopeton Oats, from Mr. Harbottle, Hexham, Northumberland.

TABLE XVIII.

	Per-centage.
Sulphuric acid,	14·80
Chlorid of sodium, (common salt,)	2·29
Potash,	14·89
Soda,	
Phosphates of lime, magnesia, and iron,	6·13
Lime,	6·99
Magnesia,	2·55
Soluble silica,	5·90
Insoluble silica,	45·75
	99·30

The watery solution contained about 37 per cent. of this ash, and from the above amount of sulphuric acid, it is quite plain that about 30 per cent. were sulphates. The soluble and insoluble silica together constitute more than half of the ash.

The leaf acts a most important part in the economy of the plant; the organic food which is derived from the atmosphere is absorbed through the pores of the leaf. In order to perform this function, it must spread out a broad expanded surface, which will come in contact with as much as possible of the surrounding air. This leaf, so extended and yet so thin, requires a degree of stiffness that it may stand forth from the stalk, and wave in the breeze, rather than hang helplessly down as if withered. For this purpose a strong framework must be furnished. In Table XVI, the average per-centage of ash from six samples of leaf, is 12½, and of this fully one half is silica. It is, I think, not unnatural to conclude that this large quantity of ash, so great a part of which is silica, is conveyed to the leaf for the purpose to which I have alluded. When the plant is uncommonly vigorous, and the leaf expands to an unusual breadth, this framework (see Table XVI) may amount to even 20 per cent.

I have now to show that the ash of the leaf varies in quality as well as quantity, and for this end give the three following analyses.

Composition of Ash from three samples of the Oat Leaf.

TABLE XIX.

	Hopeton Oats.		Sandy Oats
	1. Light loam	2. New moss.	Gravelly loam.
Salts soluble in water, chiefly sulphates and chlorids,	36·77	56·5	45·77
Phosphates of lime, magnesia and iron,	7·23	3·66	1·00
Lime and magnesia,	10·24	1·33	3·27
Silica,	45·75	38·5	49·96
	99·99	99·99	100·00

The general composition of the ash from the leaf does not greatly differ from that of some samples of top straw. To the insoluble silica in the lower line of the above, must be added, in each case, 4 or 5 per cent. of soluble silica included in the watery solution.

Having found that the top and bottom of the leaf yielded different quantities, I was desirous of further ascertaining if the quality differed also. The following table gives analyses of the ash from the two parts.

TABLE XX.

	Ash from Top of leaf.	Ash from Bottom of leaf.
Salts soluble in water, chiefly sulphates and chlorids,	43·26	48·28
Phosphates of lime, magnesia and iron,	0·85	1·15
Lime and magnesia,	3·76	2·78
Silica,	52·13	47·79
	100·00	100·00

The differences of composition in these two ashes are of the same character as those which have been noticed in the straw. Though not so striking as those differences, they show that the same rule as to the preponderance of silica at the top, and of soluble salts at the bottom, holds true in both these parts of the plant.

(*To be continued.*)

ART. XXVI.—*Observations on the uses of the Mounds of the West, with an attempt at their Classification;* by E. G. SQUIER, Chillicothe, Ohio.

THE monuments of the Mississippi valley, are divisible into two grand classes, viz. the Enclosures, familiarly known as "Forts," and the Tumuli, or Mounds;* together they constitute a single system of remains, and are the work of the same people.

The enclosures, from their magnitude and other obvious reasons, have attracted, by far, the largest share of attention; and the character of some of them, with their walls and ditches and guarded ways, is manifest, and may be regarded as settled. Of the mounds, however, little has been hitherto said or known.—The popular opinion, based, in a great degree, upon the well ascertained purposes of the barrows and tumuli occurring in certain parts of Europe and Asia, is, that they are simple monuments, marking the last resting place of some great chief or distinguished individual, among the tribes of the builders. Some have supposed them to be the cemeteries, in which were deposited the dead of a tribe or a village, for a certain period, and that the size of the mound is an indication of the number inhumed! Others that they mark the sites of great battles, and contain the bones of the slain. On all hands the opinion has been entertained, that they were devoted to sepulture alone. This received opinion is not, however, sustained by the investigations set on foot by the writer and his associate, Dr. E. H. Davis, of Chillicothe, Ohio. Nearly one hundred and fifty mounds, embracing those of every size and description, within enclosures and out of them, in groups and isolated, have been carefully excavated under their personal supervision, and every fact of importance respecting them carefully noted. The conclusion, to which these observations have led, is, that the mounds were constructed for several grand and dissimilar purposes, or rather, that they are of different classes;—the conditions upon which the classification is founded being three in number—namely: position, structure, and contents. In this classification, we distinguish—

1st. Those mounds which occur in, or in the immediate vicinity of, enclosures, which are stratified and contain altars of burned clay or stone, and which were places of sacrifice, or in some way connected with religious rites and ceremonies.

2d. Those which stand isolated, or in groups, more or less remote from the enclosures, which are not stratified, which contain human remains, and which were the burial places and monuments of the dead.

* The term *Mound* is used, in this paper, in a technical sense as synonymous with *tumulus* and in opposition to embankment, rampart, *etc.*

3d. Those which contain neither altars nor human remains, and which were places of observation or the sites of structures.

These classes are broadly marked in the aggregate; but, in some instances, they seem to run into each other. Mounds of this mixed character, as well as those which, under our present condition of knowledge respecting them, do not seem to indicate any clear purpose, have been denominated *anomalous*. Of one hundred mounds excavated, sixty were altar or sacrificial mounds, twenty sepulchral, and twenty either places of observation or *anomalous* in their character. Such however, is not the proportion in which they occur. From the fact that the mounds of sacrifice, are most interesting and most productive in relics, the largest number excavated were of that class. In the Scioto valley the mounds are distributed, between the three classes specified, in very nearly equal proportions; the mounds of observation and the anomalous mounds constituting, together, about one third of the whole number.

Mounds of Sacrifice.—The general characteristics of this class of mounds are,—

1st. That they occur only within, or in the immediate vicinity of, enclosures, or sacred places.

2d. That they are stratified.

3d. That they contain symmetrical altars of burned clay or stone, on which are deposited various remains, which, in all cases, have been more or less subjected to the action of fire.

Of the whole number of mounds of this class, which were examined, *four* only were found to be exterior to the walls of enclosures, and these were but a few rods distant from the ramparts.

The fact of stratification, in these mounds, is one of great interest and importance. The feature has heretofore been remarked but not described with proper accuracy, and has consequently proved an impediment to the recognition of the artificial origin of the mounds, by those who have never seen them. The stratification, so far as observed, is not horizontal, but always conforms to the convex outline of the mound.* Nor does it resemble the stratification produced by the action of water, where the layers run into each other, but is defined with the utmost distinctness, and always terminates upon reaching the level of the surrounding earth. That it is artificial will, however, need no argument to prove, after an examination of one of the mounds in which the feature occurs; for, it would be difficult to explain, by what singular combination of "igneous and aqueous" action,

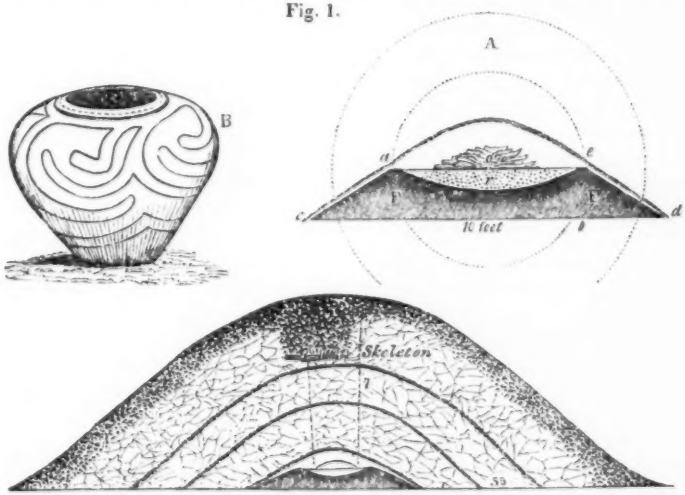
* Some of the mounds, on the lower Mississippi, are horizontally stratified, exhibiting alternate layers, from base to summit. These mounds differ in form from the conical structures here referred to, and were, doubtless, constructed for a different purpose. Prof. Forshey has described one which had layers of coarse bricks, at intervals, throughout its entire height.

stratified mounds were always raised over symmetrical monuments of burned clay or of stone.

The altars, or basins, found in these mounds, are almost invariably of burned clay, though one or two of stone have been discovered. They are symmetrical, but not of uniform size, and shape. Some are round, others elliptical, and others square, or parallelograms. Some are small, measuring barely two feet across, while others are fifty feet long by twelve and fifteen wide. The usual dimensions are from five to eight feet. All appear to have been modelled of fine clay, brought to the spot from a distance, and rest upon the original surface of the earth. In a few instances, a layer or small elevation of sand had been laid down, upon which the altar was formed. The elevation of the altars, nevertheless, seldom exceeds a foot or twenty inches, above the adjacent level. The clay of which they are composed is usually burned hard, sometimes to the depth of ten, fifteen, and even twenty inches. This is hardly to be explained, by any degree or continuance of heat, though it is manifest that, in some cases, the heat was intense. On the other hand, a number of these altars have been noticed, which are very slightly burned, and such, it is a remarkable fact, are destitute of remains.

The characteristics of this class of mounds will be best explained, by reference to the accompanying illustrations. It should be remarked however, that no two are alike in all their details.

Fig. 1.



The mound, a section of which is here given,* occurs in "Mound City," a name given to a group of *twenty-six* mounds,

* Horizontal scale of section *fifteen* feet, and the vertical *six* feet, to the inch.

embraced in one enclosure, on the banks of the Scioto river, three miles above the town of Chillicothe. It is seven feet high by fifty-five feet base. A shaft, five feet square, was sunk from its apex, with the following results:—

1st. Occurred a layer of coarse gravel and pebbles, which appeared to have been taken from deep pits, surrounding the enclosure, or from the bank of the river. This layer was one foot in thickness.

2d. Beneath this layer of gravel and pebbles, to the depth of two feet, the earth was homogeneous, though slightly mottled, as if taken up and deposited in small loads, from different localities. In one place appeared a deposit of dark colored, surface loam, and by its side, or covering it, there was a mass of the clayey soil of greater depth. The outlines of these various deposits could be distinctly traced.

3d. Below this deposit of earth, occurred a thin and even layer of fine sand, a little over an inch in thickness.

4th. A deposit of earth, as above, eighteen inches in depth.

5th. Another stratum of sand, somewhat thinner than the one above mentioned.

6th. Another deposit of earth, one foot thick, beneath which was—

7th. A third stratum of sand, below which was—

8th. Still another layer of earth, a few inches in thickness, which rested on—

9th. An altar, or basin, of burned clay.

This altar was perfectly round. Its form and dimensions are best shown by the supplementary plan, and section A. F F, is the altar, measuring from *c* to *d*, nine feet; from *a* to *e*, five feet; height from *b* to *e*, twenty inches; dip of curve *a r e*, nine inches. The sides *c a*, *e d*, slope regularly, at a given angle. The body of the altar is burned throughout, though in greater degree within the basin, where it was so hard as to resist the blows of a heavy hatchet, the instrument rebounding as if struck upon a rock. The basin, or hollow of the altar, was filled even full with fine dry ashes, intermixed with which were some fragments of pottery, of an excellent finish and elegant model, ornamented with tasteful carvings on the exterior. One of the vases, taken in fragments from this mound, has been very nearly restored. The sketch B, presents its outlines, and the character of its ornaments. Its height is six, its greatest diameter eight, inches. The material is hardly distinguishable from that composing the pottery of the ancient Peruvians, and in respect of finish, it is fully equal to the best Peruvian specimens. A few convex copper discs, much resembling the bosses used upon harnesses, were also found.

Above the deposit of ashes, and covering the entire basin, was a layer of silvery, or opaque mica, in sheets, overlapping each other; and, immediately over the centre of the basin, was heaped a quantity of burned human bones, probably the amount of a single skeleton, in fragments. The position of these is indicated by *o* in the section. The layer of mica and calcined bones, it should be remarked to prevent misapprehension, were peculiar to this individual mound, and were not found in any other of the class.

It will be seen, by the section, that, at a point about three feet below the surface of the mound, a human skeleton was found. It was placed a little to the left of the centre, with the head to the east, and was so much decayed as to render it impossible to extract a single bone entire. Above the skeleton, as shown in the section, the earth and outer layer of gravel and pebbles, were broken up and intermixed. Thus while, on one side of the shaft, the strata were clearly marked, on the other they were confused. And, as this was the first mound of the class excavated, it was supposed, from this circumstance, that it had previously been opened, by some explorer, and it had been decided to abandon it when the skeleton was discovered. Afterwards the matter came to be fully understood. No relics were found with this skeleton.

It is a fact well known, that the modern Indians, though possessing no knowledge of the origin or objects of the mounds, were accustomed to regard them with some degree of veneration. It is also known, that they sometimes buried their dead in them, in accordance with the almost invariable custom which leads them to select elevated points, and the brows of hills, as their cemeteries. That their remains should be found in the mounds, is therefore a matter of no surprise. They are never discovered at any great depth, not often more than eighteen inches or three feet below the surface. Their position varies in almost every case;—most are extended at length, others have a sitting posture, and others still seem to have been rudely thrust into their shallow graves, without care or arrangement. Rude implements of bone and stone, and coarse vessels of pottery, such as are known to have been in use among the Indians, at the period of the earliest European intercourse, occur with some of them, particularly with those of a more ancient date; while modern implements and ornaments, in some cases of European origin, are found with the recent burials. The necessity therefore of a careful and rigid discrimination, between these deposits and those of the mound builders, will be apparent. From the lack of such discrimination, much misapprehension and confusion have resulted. Silver crosses, gun barrels and French dial plates, have been found with skeletons in the mounds, yet it is not to be concluded that the mound builders were Catholics, or used fire-arms, or understood

French. Such a conclusion would, nevertheless, be quite as well warranted, as some which have been deduced from the absolute identity of certain relics, taken from the mounds, with articles known to be common among the existing tribes of Indians. The fact of remains occurring in the mounds, is in itself, hardly presumptive evidence that they pertained to the builders. The conditions attending them can alone determine their true character. As a general rule, to which there are few exceptions, the only authentic and undoubted remains of the mound builders, are found directly beneath the apex of the mound, on a level with the original surface of the earth; and it may be safely assumed, that whatever deposits occur near the exterior surface are of a date subsequent to their erection.

In the class of mounds now under consideration, we have data which will admit of no doubt, whereby to judge of the origin, as well as the relative periods, of the various deposits found in them. If the stratification already mentioned as characterizing them, is unbroken and undisturbed, if the strata are regular and entire, it is certain that whatever occurs beneath them, was placed there at the period of the construction of the mound. And if, on the other hand, these strata are broken up, it is equally certain, that the mound had been disturbed, and new deposits made, subsequent to its erection. It is in this view, that the fact of stratification is seen to be important, as well as interesting: for it will serve to fix, beyond all dispute, the origin of many singular relics, having a decisive bearing on some of the leading questions connected with American Archæology. The thickness of the exterior layer of gravel, etc., in mounds of this class, varies with the dimensions of the mound, from eight to twenty inches. In a very few instances, the layer, which may have been designed to protect the form of the mound, and which purpose it admirably subserves, is entirely wanting. The number and relative position of the sand strata are variable; in some of the larger mounds, there are as many as six of them, in no case less than one, most usually two or three.

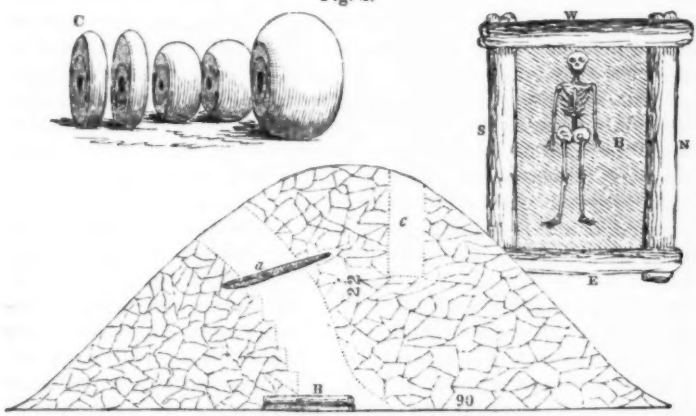
In one case which fell under our observation, and in another, of which we have an account from the person who discovered it, the altar was of stone. This altar was elevated two and one half feet above the original surface of the earth, and was five feet long by four broad. It was a simple elevation of earth packed hard, and was faced, on every side and on top, with slabs of stone of regular form, and nearly uniform thickness. They were laid evenly, and, as a mason would say, "with close joints," and though uncut by any instrument, the edges were straight and smooth. The stone is "the Waverly sandstone," underlying the coal series, thin strata of which cap every hill. This stone breaks readily, with a rectangular fracture, and hence the regularity of

the slabs is not so much a matter of surprise. This altar bears the marks of fire, and fragments of the mound builders' ornaments were found on and around it. What had originally been deposited there was probably removed by the modern Indians, who had opened the mound and buried one of their dead on the altar.

Mounds of this class are most fruitful in relics of the builders. On the altars have been found, though much injured and broken up by the action of fire, instruments and ornaments of *silver*, *copper*, *stone* and *ivory;* beads of silver, copper, *pearls* and shell; spear and arrow-heads of flint, quartz, garnet and *obsidian;* fossil teeth of the shark; teeth of the alligator; marine shells; galena; sculptures of the human head, and of numerous animals; pottery of various kinds, and a large number of interesting articles, some of which evince great skill in art. No description of these can be given here.

Mounds of Sepulture.—The mounds of sepulture stand apart from the enclosures, and, in their average dimensions, greatly exceed those of the first class. The celebrated mound at Grave creek was of this class. They lack the gravel and sand strata, which characterize those already described, and are destitute of "altars." They invariably cover a skeleton, (sometimes more than one, as at Grave creek,) which, at the time of its interment, was enclosed in a rude framework of timber, or enveloped in bark or coarse matting, the traces, in some instances the very *casts* of which, remain. The structure of one mound of this class, will serve to exhibit their peculiarities.

Fig. 2.



The mound, of which the above is a section,* stands on the third "bottom" or terrace of the Scioto river, six miles below the

* Horizontal scale *thirty* feet, and vertical *fifteen* feet, to the inch.

town of Chillicothe. There are no enclosures nearer than a mile, though there are three or four other mounds, of smaller size, on the same terrace, within a few hundred yards. The mound is twenty-two feet high, by ninety feet base. The principal excavation was made, (as represented by the dotted lines in the section,) from the west side, commencing at about one-third of the height of the mound from the top. At ten feet below the surface, occurred a layer of charcoal, (*a*,) not far from ten feet square, and from two to six inches in thickness, slightly inclined from the horizontal, and lying mostly to the left of the centre of the mound. The coal was coarse and clear, and seemed to have been formed by the sudden covering up of the wood, while burning, inasmuch as the trunks and branches retained their form, though entirely carbonized, and the earth immediately above, as well as below, was burned of a reddish color. Below this layer, the earth became much more compact and difficult of excavation. At the depth of twenty-two feet, and on a level with the original surface, immediately underneath the charcoal layer, and, like that, somewhat to one side of the centre of the mound, was a rude timber framework, (B,) now reduced to an almost impalpable powder, but the *cast* of which was still retained in the hard earth. This enclosure of timber, measured from outside to outside, was nine feet long by seven wide, and twenty inches high. It had been constructed of logs laid one on the other, and had evidently been covered with other timbers, which had sunk under the superincumbent earth, as they decayed. The bottom had also been covered with bark, matting, or thin slabs,—at any rate, a whitish stratum of decomposed material remained, covering the bottom of the parallelogram. Within this rude coffin, with its head to the west, was found a human skeleton, or rather the remains of one, for scarcely a fragment as long as one's finger could be recovered. It was so much decayed that it crumbled to powder, under the lightest touch. Around the neck of the skeleton, forming a triple row, and retaining their position, as originally strung and deposited with the dead, were several hundred beads, made of ivory, or the tusks of some animal, (C.) Several of these still retain their polish, and bear marks which seem to indicate that they were turned in some machine, instead of being carved by hand. A few laminæ of mica were also discovered, which complete the list of articles found with this skeleton. The foot of the skeleton was nearly in the centre of the mound. A drift beyond it developed nothing new, nor was a corresponding layer of charcoal found, on the opposite side of the mound. It is clear therefore, that the tumulus was raised over this single skeleton. In the case of a mound of this class, opened at Gallipolis, on the Ohio river, the chamber enclosing the skeleton was found just below the original surface,—a fact which can always be detected

by a strongly marked line, and the uniform drab color of the earth beneath it.

The layer of charcoal is not uniformly found in mounds of this class, though it is a feature of frequent occurrence. It would seem to indicate that sacrifices were made for the dead, or that funeral rites of some kind were celebrated. The fire, in every case, was kept burning for a very brief space, as is shown by the lack of ashes, and the slight traces of its action left on the adjacent earth. That it was suddenly heaped over, is also proved by the facts already presented.

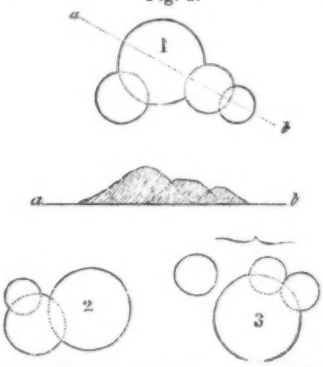
Bracelets of copper and silver; beads of bone, ivory and shell; mica plates and ornaments; stone instruments of various kinds, some of which are identical with those found in mounds of the first class, etc. etc., are found with the skeletons. In every instance falling within our observation, the skeleton has been so much decayed, that any attempt to restore the skull, or indeed any portion of it, was hopeless. Considering that the earth around these skeletons is wonderfully compact and dry, and that the conditions for their preservation were exceedingly favorable, while, in fact, they are so much decayed, we may form some estimate of their remote antiquity. In the barrows and cromlechs of the ancient Britons, entire and well preserved skeletons are found, although having an undoubted antiquity of 1500 years.

In some of the sepulchral mounds, as has already been stated, the sarcophagus, if we so please to term it, was omitted by the builders, the dead body having been simply enveloped in bark or matting. Perhaps this course was most frequently pursued. In these cases, the original surface appears to have been carefully smoothed and leveled, for a space ten or twenty feet square, which space was covered with bark. Upon this was deposited the dead body, and, by its side, such personal ornaments or implements as were deemed proper, the whole being covered over with another layer of bark, and the tumulus raised above. Instances have occurred in which it is clear that burial by *incremation* was made, but these are comparatively rare.* In the celebrated mound at Grave creek, *two* sepulchral chambers were discovered, one at the base, another at a higher point. The lower one contained a single skeleton, and the upper two. This mound, in this respect, is somewhat extraordinary. It may be conjectured, with some appearance of reason, that it contained the bones of the family of a chieftain, or distinguished individual, among the builders. It is common to find two or three, sometimes four or five, sepulchral mounds, in a group. In such cases, it is always to be remarked, that one

* Did the scope or limits of this paper permit, the facts bearing upon this point would be here presented. As it is, the reader is respectfully referred to certain publications which are shortly to appear, under the auspices of the New York Ethnological Society.

of the group is much the largest, twice or three times the dimensions of any of the others, and that the smaller ones are arranged around its base, generally joining it, thus evincing an intended dependence and close connection between them. Plans of three groups of this description are given in the annexed figures. May we not conclude that such a group is the tomb of a family—the principal mound covering the head of the same, the smaller ones its various members? In the Grave creek mound, it is possible that, instead of building a new mound, an additional chamber was constructed upon the summit of the one already raised—a single mound being thus made to occupy the place of a group.

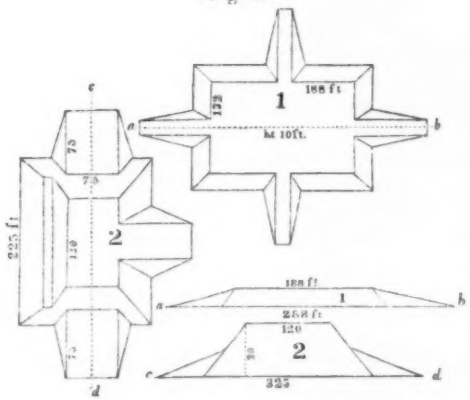
Fig. 3.



Mounds of Observation.—On the tops of the hills and on the jutting points of the table lands, bordering the vallies in which the earthworks of the West are found, mounds occur in considerable numbers. The most elevated and commanding positions are frequently crowned with them, suggesting at once the same use to which the cairns of the Celts were applied—that of signal or alarm posts. On a high hill, opposite Chillicothe, 600 feet in height, the loftiest in the whole region, one of these mounds is placed. A fire built upon it would be visible for a distance of fifteen or twenty miles up and down the river, as well as for a number of miles up the valley of Paint creek,—a broad and fertile valley, abounding in ancient monuments. Between Chillicothe and Columbus, a distance of 45 miles, there are about twenty mounds, so placed that, it is believed, if the country were cleared of forests, signals by fire could be transmitted, along the whole line, in a few minutes. Our examination of this description of mounds, from a variety of causes, has been comparatively limited. So far as our personal observation goes, they contain none of the remains found in the two classes of mounds, just described; and, although there are traces of fire around most of them, the marks are not sufficiently strong to justify fully, the inferences that they were *lookouts* and fires used as the signals. Indeed, it is certain that, in some cases, they contain human remains, undoubtedly those of the mound builders. It is possible that a portion were devoted to sepulture, another portion to observation, or that some answered a double purpose. This is a point which remains to be settled, by more extended observation.

There is another description of mounds which should properly be here mentioned. Their purposes admit of no doubt. They consist of pyramidal structures, or "elevated squares," and are found almost invariably within enclosures. They are sometimes of large dimensions. Those at Marietta are fair examples of the class, and No. 1, Fig. 4, exhibits their structure and dimensions.

Fig. 4.



No. 2, is an elevation of a similar mound, on the banks of Walnut Bayou, Madison Parish, Louisiana, and is introduced, incidentally, to show the connection between the monuments of the lower Mississippi and Mexico, and those of the Ohio valley. None of these, so far as examined, contain remains. They were obviously designed as the sites of temples or structures which have passed away, or as "high places" for the performance of certain ceremonies. Perhaps they deserve to occupy a place by themselves, in the classification here attempted.

Anomalous Mounds.—It will be impossible, within the compass of this paper, to enter into the details which a proper notice of these mounds would require. Such a notice would necessarily involve a description of almost every one thus characterized. A single mound was examined which contained an altar and also a skeleton with its rude enclosure of wood. It was elliptical in shape, measuring 160 feet in length, 60 in width, and 25 in height. The altar occupied one centre of the ellipse, the chamber of the skeleton the other. Of the twenty-six mounds embraced in "Mound City," *six* are of very small dimensions, not exceeding three feet in height. Within each of these was deposited a quantity of burned human bones, in fragments, not exceeding, in any case, the amount of a single skeleton. No relics were found with these, though in one instance a fragment of an altar, a couple of inches

square, was observed with the bones, leading to the conclusion that they were taken up from the altars, in the adjacent larger mounds, and afterwards finally deposited here.

General Observations.—Whether these classes are maintained throughout the West, is a question which a systematic examination, carried on over a wide field, alone can determine. In almost every case, falling within our knowledge, when mounds have been thoroughly examined by competent persons, some of the features here marked, have been noticed. It is conjectured, that the "brick hearths," of which mention has occasionally been made, were the "altars," already described as belonging to a certain class of mounds. Nothing is more likely than that some of them were left uncovered by the builders, and subsequently hidden by natural accumulations, to be again exposed by the invading plough or the recession of the banks of streams. The indentations occasioned by the passage of roots across them, or by other causes, would naturally suggest the notion of rude brick hearths.

ART. XXVII.—*Description of a Fossil Maxillary Bone of a Palæotherium, from near White River;* by HIRAM A. PROUT, M. D.

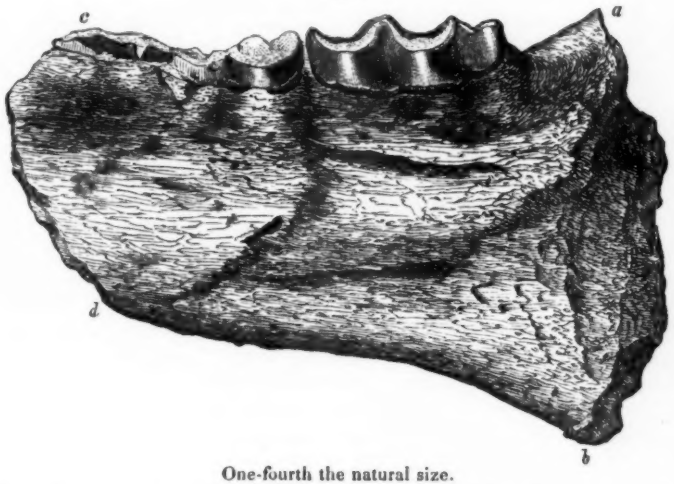
THE Palæotherial bone here described, was sent to me sometime ago by a friend residing at one of the trading posts of the St. Louis Fur Company, on the Missouri River. From information since obtained from him, I learn that it was discovered in the Mauvais Terre, on the White River, one of the western confluents of the Missouri, about one hundred and fifty miles south of St. Pierre, and sixty east of the Black Hills, at a point which would very nearly correspond with the intersection of latitude 43° with longitude 26° west of Washington.

The Baculites and the Inoceramus which accompanied it, and which I at first supposed belonged to the same locality, were found in another formation—probably the cretaceous—distant about one hundred miles, and included in the Grande Detour or Great Bend of the Missouri River. The Inoceramus appears to correspond precisely with that figured by Professor Hall, in Frémont's Expedition: it has however both valves, and may possibly be a distinct species.

This fossil bone is a fragment of the inferior maxillary of the left side, consisting of the posterior part of the bone, together with the last three molar teeth. The ramus is much fractured and presents an irregular surface; yet the general direction of its outline may be made out. The length of this fragment is

fifteen inches, its depth from the highest point of the ramus (*a*) to the lowest (*b*), is nine and a half inches: it narrows regularly forward so as to measure only three and a half inches from the lower surface of the bone at (*d*), to the alveolar process of the antepenultimate tooth at (*c*). The inner surface of the

Fig. 1.



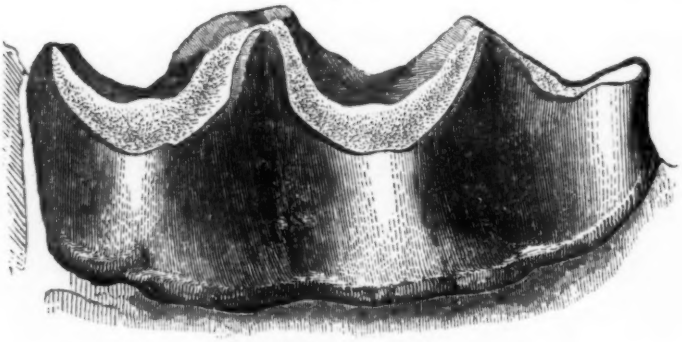
One-fourth the natural size.

bone is more uniform, being marked merely by depressions for the attachment of muscles. The alveolar portion is here very prominent and well rounded, the teeth being planted more than an inch from a vertical line which is tangential to the inner surface of the bone. It is covered in places with a concretionary matter which could not be removed without injury to the specimen; on analysis, this was found to consist chiefly of carbonate of lime, with some alumina, and a small proportion of silex.

The last molar tooth has the three lobes of the Palæotheria, as shown in fig. 2. The inner surface is nearly smooth and flat, and shows no trace of lobes. The size of the tooth from posterior to anterior sides is $4\frac{1}{2}$ inches, of which $1\frac{5}{8}$ inches belong to the *anterior* lobe, the *same* to the *middle*, and $1\frac{1}{4}$ inches to the *posterior*. In an upper view, the two larger lobes have a deltoid form, with the sides somewhat convex, and a rounded outer angle. The thickness through from the outer to the opposite side, is $1\frac{3}{4}$ inches. The enamel of the inner side folds over the surface, covering nearly a semicircular space, and leaving between it and the edge of the posterior enamel, a sub-crescent-shaped space (deltoido-lunate) of dentine, somewhat concave, which is nearly seven-eighths of an inch broad at its widest part.

These crescent-shaped areas of the two lobes are connected by a continuous tract of dentine, nearly $1\frac{1}{2}$ lines wide at the narrowest part; and the same tract continues from the middle lobe to the

Fig. 2.



Four-fifths the natural size.

posterior; upon the latter it does not widen over the interior, as the reflexed inner enamel covers the whole of the crown, excepting a narrow space adjoining the posterior enamel. The prominent points of the crown between the lobes project about half an inch; and probably much more in the perfect tooth.

The *fifth* and *sixth* molars (*first* and *second* true molars) resemble the one described, (except that they want the third lobe,) and the dentine area on the crown of each lobe is much larger. The sixth is $3\frac{1}{8}$ inches from front to posterior side. The posterior lobe is 2 inches from the outer to the inner surface, and $1\frac{7}{8}$ inches long in the line of the jaw. The whole distance on the jaw occupied by the three teeth is eleven inches. In the largest Palæotherium, hitherto described, the P. magnum, the same teeth occupy a space scarcely one-third that of the Missouri animal.

St. Louis, Dec. 10, 1846.

ART. XXVIII.—*Observations upon the Development of Electricity in Bands of Leather;* by JOHN M. BATCHELDER.

HAVING had an opportunity to examine the electrical condition of the bands of a cotton mill, and finding them very highly excited, many interesting facts were brought out, which I here detail.

The mill is situated on the sea-coast of Maine, where the climate is very moist and consequently less favorable for the devel-

opment of electricity than the dry and elevated lands of the interior of the country. There are several hundred bands in a mill, all of which are electrically excited in a greater or less degree; those which turn upon wooden drums or pullies, whereby they are partially insulated, become very highly charged, the intensity of the excitement being much increased by the crossing of the band, the transmission of power, and a high velocity.*

The one which was used for making most of the experiments detailed below, is about thirty-five feet in length, nine inches wide, and moves sixteen hundred feet per minute, passing around two wooden drums, which revolve upon an iron shaft one hundred and eighty times per minute, and in clear weather a spark may be taken on the knuckle held below the band at a distance of one foot and five inches.† Owing to the imperfect conducting power of the leather, this discharge is local; were it to take place from all parts of the excited surface at the same instant, it would be unsafe to discharge it in this manner. On presenting the end of the finger the striking distance is found to be three feet; the point of a black lead pencil shows a distinct brush when held in the hand four feet from the band, and a steel point becomes luminous at the distance of seven feet. When the bands are in this condition, the first processes of the cotton manufacture are attended with serious inconvenience; the fine filaments of the cotton repel each other, causing a great deal of waste, and in several instances the "drawing," as it is termed, has been lifted from the machine to a band four feet distant from it. These difficulties are now partially removed by extending a conductor of wire to an iron steam pipe which passes through the rooms, and by emitting jets of steam near those bands that are most highly charged. It is probable that the finest kinds of yarn can never be profitably manufactured in this country, the moist climate of England being much more favorable for this branch of the trade.

Let a piece of leather about two feet in length, with one edge slightly curved, be presented to the band, and a succession of brilliant flashes and jets is immediately produced, giving a very perfect imitation of the Auroral light. While engaged in this experiment, I noticed that, in some cases, the current of electricity continued to flow in the direction first established, even when a substance of the same conducting power is held nearer to the excited band; for instance, if a piece of leather be bent like a horse-shoe, and the extremities be brought towards the band in

* Dr. Franklin suggested to his friend, Mr. Bowdoin, that a portable electrical machine might be constructed by making the cylinder of leather, stuffed and properly mounted.

† In Vol. xxxvii, p. 197, of this Journal, a band is mentioned which gives a spark of two inches in length.

such a manner that a pencil of light may be seen passing to *one* extremity, and then the leather be so inclined that the distance from the *other* extremity to the band is but half the distance of *that* receiving the electricity, the jet still continues to flow in its first direction in preference to taking the shorter path offered by the opposite end. There is evidently a tendency in the fluid to follow in the direction first commenced.

For the purpose of ascertaining whether metallic particles would become luminous in an atmosphere highly charged with electricity, very minute particles of metallic dust were projected against the belt, but I was unable to detect any light either during their ascent or descent. The passage of a jet of steam through the same atmosphere was not attended with light.

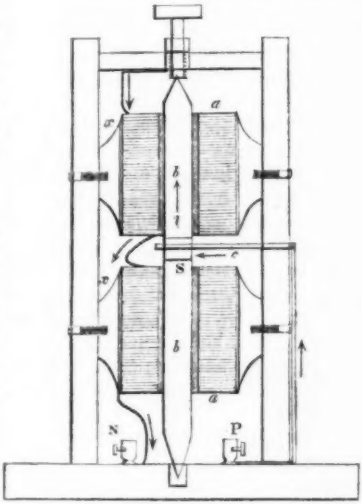
Let two imperfect conductors be placed at equal distances from the band, their points directed towards it and separated a few inches from each other, then if air be blown violently from a glass tube upon one of the jets, it will disappear; the other now conveying a larger quantity of the fluid becomes brighter; let the tube be directed to this and it is extinguished, the light appearing again upon the first, thus changing from one to the other as rapidly as the tube can be moved.

It hence appears probable, that the flickering of the Auroral columns may, to a certain extent, be attributable to the motion of the air.

ART. XXIX.—*Revolution of a Magnet on its own Axis without the use of Mercurial Conductors, and also without Visible Support;* by CHAS. G. PAGE, M. D., Prof. Chem., Columbian College, Washington, D. C.

THE rotation of a magnet upon its own axis is among the most interesting of all the phenomena connected with the reciprocal action of magnets and currents, and various ingenious improvements have been made upon the original device of Ampère for its illustration. The use of mercurial conductors—a feature common to them all—is objectionable for several reasons. To dispense with the mercurial cells, and substitute for them solid conductors, seemed to require some other changes in the arrangement, by which greater magnetic power should be employed, than can be imparted to bars of steel of the dimensions usually adopted. The friction of a platinum wire attached to the magnet in the usual manner, and revolving in a circular cell of mercury, though very trivial in itself, operates considerably to retard the motion of the magnet, for the reason that the point of resistance is very far from the centre of motion. By the substitution of solid connexions

for the mercurial, the resistance is brought much nearer to the centre of motion, and amounts perhaps to very little more than under the old plan. In order to obtain a powerful magnet for this purpose, I make an arrangement similar to that shown in the accompanying figure, which represents a vertical section through the centre of the apparatus. *a*, *a*, are two helices of insulated wire, secured to the posts of the framework by means of the blocks of hard wood *x*, *x*. The bar of soft iron *b*, *b*, is about ten inches long and one inch diameter, and delicately supported upon steel pivots. The helices through which the bar passes, have a central opening sufficient to allow a space of about one-sixteenth of an inch between them and the surface of the bar. Near the centre of the bar, at S, it is covered with a thin ferule of silver with which the conductor *c*, also of silver, is in contact by slight pressure. This conductor is in connexion with the binding screw cup P. The upper helix has one of its ends connected with the bearing of the upper pivot, its other with the upper end of the lower helix; and the lower end of the latter is connected with the cup N. The course of the current is seen by the arrows, and the whole appears very simple and easy of construction. The bar of soft iron and other parts of the instrument may be much smaller than the dimensions above given, but I have preferred for my own use the very large size as better for "class illustration." The helices being connected with twelve or more pairs of Grove's battery, the bar of soft iron becomes powerfully magnetic, and by the action of the current passing through its upper half, revolves with astonishing rapidity. By substituting for the current through the upper half of the magnet, one of much greater quantity from an independent single pair of plates, the effect is greatly increased and exhibits the most rapid rotation I have ever witnessed. But the most interesting feature in connection with this instrument, is, that during the rapid motion the bar is without visible support, the upper and lower bearings serving only as guides to keep it in place. By inspection of the figure it will be seen that the magnetic bar projects farther below the lower helix, than it does above the



upper. When this is the case, the action of the current in the helices raises the bar from off its rest below, the pivot being however retained within the socket to keep the bar in place. Play enough should be given in the socket above, to allow the bar to rise. The friction being thus very much diminished, the extra friction of the solid, over the mercurial connexions, is more than compensated.

Washington, D. C., Jan. 25, 1847.

SCIENTIFIC INTELLIGENCE.

I. Chemistry and Physics.

1. *On a Common Origin of the Acids* $(CH)nO_4$ *with a boiling point below* 300° *Centigrade;* by Dr. Jos. Redtenbacher, (Phil. Mag. for Dec., 1846, p. 503.)—The composition of a large number of organic acids is such that the so-called *hydrated* acids may be represented as composed of a hydro-carbon, which is a multiple of CH, and four equivalents of oxygen. To this group of homologous acids belong the acetic, valerianic, and the volatile acids of butter, in which n is always some multiple of 2. This increase in the value of the factor is attended with a regular increase in the boiling point of the acid. According to the late researches of Kopp and Fehling, it equals 20° C. when the value of n is augmented by 2.

It is probable that all these acids may be produced from bodies like aldehyde of the formula $(CH)nO_2$, by a simple process of oxydation. This has been already established with regard to the acetic, metacetonic, butyric, valerianic, and enanthylic acids.

Dr. Redtenbacher has examined the volatile acids which result from the action of nitric upon oleic acid. The oleic acid was boiled in a retort with an excess of strong nitric acid till all oily matter disappeared. Water was then added and the mixture distilled. The product collected in the receiver consisted of a stratum of the oily acids and a watery solution of the more soluble ones. The oily portion was neutralized by baryta and the different salts separated by crystallization. The aqueous solution contained acetic, metacetonic, and butyric acids, and an examination of the baryta salts showed that not less than nine acids had been formed, of the type $(CH)nO_4$; the value of the factor being augmented by 2 from 4 to 20, and the boiling point rising from 120° C. to 280° C. They were the acetic, metacetonic, butyric, valerianic, caproic, enanthylic, caprylic, pelargonic, and capric. The metacetonic acid is obtained by the action of potash on sugar, and by the oxydation of metacetone (an aldehyde); the butyric, caproic, caprylic, and capric, are known as the volatile acids of butter, and the pelargonic acid is so named from its supposed identity with a fatty acid, discovered by Pless in the rose geranium, *Pelargoniun roseum.*

This origin of the volatile fatty acids gives a key to the mode of their formation in nature. The experiments of the author and others

upon the fat of fowls, geese, snakes, badgers, hares, and particularly that of man, show that small portions of these acids, principally the caprylic, caproic, and valerianic, are always present. The odor of caprylic acid, when much diluted with air, resembles closely that of the sweat of a healthy man, and Dr. Redtenbacher suggests that as this acid is present in considerable quantities in human fat, it may pass off with the perspiration, after strong exercise and heating.

2. *On the Solution of Oxygen in fused Litharge, and the circumstances attendant upon the production of Litharge on a large scale;* by M. Fel. Le Blanc, (Ann. de Chim. et de Phys., Apr., 1846.)—The opinion of M. Fournet that litharge is per-oxydized during fusion, is not confirmed by Le Blanc, who has ascertained that the phenomena are owing to a simple solution of oxygen and probably azote, analogous to the absorption, or rather solution of oxygen by fused silver. The quantity is stated to be about 1½ cub. in. per pound.

At Poullaouen, where the experiments were made, about 20,000 lbs. of argentiferous lead are operated upon at a time. The *abstricks* or black litharge, containing sulphur, are drawn off first. At the end of sixteen to twenty hours they are succeeded by the marketable litharge. The pure article is received in a conical iron pot of thirty quarts capacity. It immediately solidifies at the surface and becomes yellow or greenish yellow in color. After a time the mass cracks in every direction, sometimes with a sort of explosion, and becomes a friable, crystalline, reddish litharge, which, after preparation, is sold. The yellow crust retaining its color and cohesion, is set aside and revived. If the vessels are too small the whole mass retains the yellow color and does not exfoliate. The red litharge did not give off oxygen by heating, and yet when suddenly cooled assumed the yellow form. Operated upon by nitric acid, no peroxyd was formed, showing the absence of minium. This is another case of dimorphism, resembling that of sugar, arsenious acid, iodid of mercury, &c. G. C. Schaeffer.

3. *On the Estimation of Silver, by Gay Lussac's Process, when Mercury is present;* by M. A. Levol, (Ann. de Chim. et de Phys., Apr., 1846.)—The assay of silver by Gay Lussac's method has become universal. One single exception to the perfection of the process has remained, viz., the presence of mercury, and this is not of common occurrence. M. Levol has conquered this difficulty by the following process:—

The assay, as usual, is dissolved in 5 cub. centimeters of nitric acid of 32° Baumé; it is then supersaturated with 25 cub. cent. of caustic ammonia; the normal liquor is then added, and finally the excess of ammonia supersaturated by 20 cub. cent. of acetic acid. The operation is finished in the usual manner.

Gay Lussac (Ann. de Chim. et de Phys., June, 1846) has verified the accuracy of Levol's process, and proposed to shorten it by adding at once 10 grammes of acetate of ammonia. Acetate of soda answers equally well. The nitric acid should be completely saturated by the soda of the acetate. G. C. S.

4. *A new Method of estimating Lead;* by M. Flores Domonte, (Comptes Rendus, May, 1846.)—This process is similar to that of Pelouze for copper. The lead is thrown down and redissolved by caustic

potash, and then precipitated by a standard solution of sulphuret of sodium. The mode of operation is precisely the same as with copper, (see this Journal, ii Ser., vol. ii, p. 259,) with this difference, that as the equivalent of lead is higher than that of copper, the solution of sulphuret of sodium should be diluted with three parts of water. This method gives results within one per cent.; and sometimes much nearer.

Tin, antimony and arsenic, do not interfere with the process, and it is not necessary to filter from the insoluble oxyds. Iron, nickel, and cobalt, although not often met with in the assay, are said not to affect the result. Zinc precipitates after the lead, and by the change in color of the precipitate in fact assists in determining the total absence of lead.

When copper is present it is first determined by the method of Pelouze; a like per-centage of copper is then added to one gramme of pure lead and the analysis of the mixture shows how many divisions are to be subtracted on account of the copper.

Bismuth interferes with the estimation of the lead, but from its high price is not likely to be present as an adulteration. G. C. S.

5. *On the Solubility of Alumina in Ammoniated Water;* by F. MALAGUTI and J. DUROCHER, (Ann. de Chim. et de Phys., Aug., 1846, and Comp. Rend., May, 1846.)—This research is intended to establish;—

That if ammonia is employed to precipitate alumina in the absence of ammoniacal salts, a *very considerable* proportion may remain in the solution;

That the quantity of ammoniacal salt, necessary for the complete precipitation of the alumina, increases with the *volume of the solution;*

That even in the absence of salts of ammonia, the alumina may be *entirely* precipitated from the solutions, irrespective of their volume or of the quantity of ammonia contained in them, provided a sufficient time be allowed to elapse between the precipitation and filtration, the air being carefully excluded;

That the most suitable reagent for the complete precipitation of alumina, without reference to the volume of the solution, the absence of ammoniacal salts, or the length of time, is the sulphuret of ammonium.

The authors seem to undervalue the precautions given by Rose, Fresenius, and others, for undoubtedly accurate results have been obtained by these methods: neither do they assign any determined rate of solubility to alumina, which of course is impossible, as spontaneous separation takes place. Still, however, these researches are of value, as they show the liability to error and the amount of error possible.

It is worthy of remark that the spontaneously precipitated alumina is no longer gelatinous, but granular and less soluble in acids.

G. C. S.

6. *Action of Perchlorid of Phosphorus on Organic Substances;* by AUG. CAHOURS, (Comptes Rendus, May, 1846.)—The perchlorid has no effect upon carbo-hydrogens, such as benzine and retinaphtha, but the hydrate of phenyle and anisol (differing from the former by the addition of two equivalents of oxygen) are violently attacked, and form new compounds. The alcohols are known to produce chlorid, when treated with perchlorid of phosphorus—by the elimination of O_2 without replacement, and by the substitution of Cl for H. The action upon

bodies containing O_4, such as benzoic acid, would become interesting, as we should reproduce the compounds of the benzoyle series.

Experiment confirmed this conjecture. Benzoic acid was violently attacked by the perchlorid, with the formation of a substance in every respect identical with the chlorid of benzoyle formed from oil of bitter almonds. Cinnamic and cuminic acids, in like manner, formed true chlorids of cinnamyle and of cumyle, which were decomposed slowly by water, rapidly by an alkaline solution, and which formed amides by the action of dry ammonia.

The acid of the acetic series did not afford analogous results.

The reaction upon a volatile acid containing O_6, was found to be the same; anisic acid gave chlorid of anisyle by the loss of O_2 and the substitution of Cl for H. The substance obtained was perfectly pure, reformed anisic acid under the influence of alkalies, and gave anisamide with ammonia.

These results are highly curious, for as M. Cahours remarks, the action of amalgam of potassium, discovered by Melsens, in restoring a chlorine compound to its primitive, renders us able to return from benzoic acid to oil of bitter almonds—from cinnamic acid to oil of cinnamon. As these metamorphoses are in a contrary direction to those hitherto possible, the perchlorid of phosphorus becomes one of our most important reagents, leading to the formation of many new and interesting compounds. G. C. S.

7. *On the transformation of Hippuric acid into Benzoic acid and Sugar of Gelatine;* by M. Dessaignes, (Ann. de Chim. et de Phys., May, 1846.)—When hippuric acid is boiled for about a half an hour in hydrochloric acid, it no longer crystallizes on cooling, but is decomposed and affords the quantity of benzoic acid indicated by theory. After separating the benzoic acid, the filtrate, on evaporation, yields long prismatic crystals which are acid and contain nitrogen—hydrochloric acid enters into their constitution. These crystals neutralized by carbonate of lead or soda yielded, after the chlorids had been separated from the solution, a crystalline substance with a sweet taste, and containing nitrogen. This, M. Dessaignes found to be sugar of gelatine. In fact $C_{18}H_9NO_6 - C_{14}H_6O_4 = C_4H_3NO_2$, and if we add to this one and a half equivalents of water, we obtain half an equivalent of sugar of gelatine, according to Mulder and Boussingault. M. Dessaignes, however, thinks that to this residue we must add two equivalents of water, and that the true formula of gelatine sugar is $C_4H_5NO_4$. This conjecture is verified by the analysis of Laurent, given on next page.

The action of nitric, sulphuric and oxalic acids is attended with a similar transformation of the hippuric acid. Finally, potash or soda in excess produces the same effect. Hippuric acid therefore resembles the acid amides, for when boiled with acids or alkalies, the elements of water are added, and it is transformed into an acid and a base containing nitrogen, which in this case replaces ammonia. The attempt to combine benzoic acid and sugar of gelatine and thus to reproduce hippuric acid, was not successful. G. C. S.

8. *Benzoic Compounds.*—Pelouze having obtained a crystalline substance by the action of moist chlorine on the oil of bitter almonds, Laurent found on analysis that it had the composition of benzoic acid,

but was distinguished by forming benzamide under the action of ammonia. In attempting to form this substance, Laurent obtained only benzoate of hydruret of benzoyle. This latter gave C. 76·20, H. 5·45, answering to the formula $C_{56}H_{24}O_{10}$, or one equivalent of benzoic acid and three equivalents of hydruret of benzoyle. This differs from the formula of Liebig, which combines two equivalents of the hydruret with one of acid. G. C. S.

9. *On Sugar of Gelatine, &c.;* by Aug. Laurent, (Comptes Rendus, May, 1846.)—A perfectly crystallized specimen gave C. 32·10, H. 6·66, N. 18·95, corresponding to the formula $C_4H_5NO_4$ proposed by Dessaignes. Sugar of gelatine is, therefore, isomeric with the carbonate of methyle or urethylane. G. C. S.

10. *On the Amides;* from a letter of Malaguti, (Comptes Rendus, May, 1846.)—With a view to the study of these compounds, Malaguti has prepared large quantities, and has added several amides to the list of those already known. He says, there is no difficulty in preparing them and in discovering new ones. When we have an acid, we have generally an ether, and when we have an ether we have an amide. The difficulty consists in the preparation of very pure acids.

A preliminary investigation of the action of heat upon these compounds, leads to some interesting results which we cannot, however, give in detail. The mode furnished is to examine the action of heat upon the salt of ammonia, and to separate these results from those produced by the heating of the amide; in this way the decomposition peculiar to the latter, is supposed to be shown. G. C. S.

11. *Asparamide.*—When pulverized asparamide is acted upon by an alcoholic solution of potash, there forms immediately a syrupy matter, scarcely soluble in the supernatant liquid; washed with alcohol and dried, it gives the formula $C_8H_7N_2O_6K$, or asparamide, in which one equivalent of hydrogen is replaced by one equivalent of potassium. A similar compound with copper has been obtained by Piria.

As other amides form saline compounds with metals, Laurent remarks that as chemists do not admit the existence of water in amide, he does not see why they suppose the acids called *hydrated*, to contain water, for the reaction with bases, is in both cases precisely the same. G. C. S.

12. *On the Formation of Chloro-cyanilide and Fluo-silicanilide;* by Aug. Laurent and J. Delbos.—(Comptes Rendus, Apr., 1846.) The action of ammonia upon acids forming amides and of the remarkable base aniline forming analogous compounds, anilides, has led Laurent and Gerhardt to the investigation of the combinations of these bodies with the fluorids and chlorids.

With chlorid of cyanogen and fluorid of silicon, aniline forms apparently homogeneous substances, but which are in reality mixtures of the anilides above named with chloro-hydrate of aniline in the one case, and fluo-hydrate of aniline in the other.

By analogy it is very probable that the corresponding combinations of ammonia are in reality mixtures of amides and salts of ammonium. G. C. S.

13. *On the Growth of Bone in the Hog;* by M. Boussingault, (Ann. de Chim. et de Phys., Apr., 1846.)—This curious investigation

is in part a sequel to that of the development of fat in animals, and based upon facts determined during that investigation.

The ashes of the skeleton of a pig just littered weighed 20·73 grammes, containing 84 per cent. phos. lime and 11 p. c. phos. mag. A hog at eight months, fed in the usual manner, gave 1353 grms.; phos. lime 91·3 p. c., phos. mag. 3·6 p. c. A third, the same weight as the last when killed, was fed for ninety-three days on potatoes, and gave 1586 grams. of bone ashes, containing phos. lime 92·4 p. c., phos. mag. 3·8 p. c. Thus during the first eight months, and on a rich diet, the assimilation of bony matter proceeded rapidly. But during the ninety-three days the hog was fed with potatoes, the increase per day was much less than before. On examining the ash of the potatoes, it was found that the whole quantity consumed by the animal, had not supplied as much lime as the hog had assimilated in that time, and when the quantity of lime in the excrement, which was also analyzed, was taken into account, the deficiency was still greater.

The analysis of the water taken with the potatoes (the exact quantity used being known) showed that the deficiency of lime was supplied from the water, and that the two sources together had furnished no more lime than the hog had used. Without the water then, the animal would have suffered and after a time have died.

The author insists upon the great importance of the saline contents of spring water, both as furnishing the required salts to stock, and finally adding to the value of the manure. That the quantity of the salts is not unworthy of notice, is shown by a computation of the inorganic matter taken in the drink of the cattle at Bechelhoun; in one year this amounts to 876 kilogrammes, about 1800 lbs. The artesian well at Grenelle brings to the surface in each year 59,860 kilogrammes or about 134,700 lbs. of solid matter, nearly all of which is useful in the animal or vegetable economy. G. C. S.

14. *Gun-Cotton.*—Pelouze has pointed out various characters distinguishing the Xyloidine of Braconnot from gun-cotton, and he gives to the latter, (or the material obtained by the action of nitric acid on vegetable fibre without a destruction of its texture,) the name of *Pyroxyline.*

Pelouze mentions the following points of difference.

Xyloidine is very soluble in nitric acid, and this solution which is rapidly made, is destroyed in twenty four hours or less, it becoming changed into a deliquescent acid, as determined by Pelouze eight years since.

Pyroxyline does not dissolve even in an excess of nitric acid; it remains in it for days without alteration, or even loss of weight.

Xyloidine leaves a considerable residue of carbon when inflamed or detonated.

Pyroxyline leaves no residue, and comports itself very differently as is well known.

Xyloidine may be analyzed like other organic matters by means of oxyd of copper, with the single precaution of augmenting a little the proportion of this oxyd.

Pyroxyline in the same circumstances, explodes and breaks the vessel, even when one hundredth the quantity is used.

Five milligrammes of *xyloidine* heated in a tube full of mercury are decomposed without danger, while the same quantity of *pyroxyline* produces a violent detonation.

One hundred parts of dry starch, dissolved in concentrated nitric acid precipitated by water immediately after the disappearance of the starch, give for a maximum 128 to 130 parts of *xyloidine*.

One hundred parts of cellulose (cotton or paper) in contact with mono-hydrated nitric acid, either for a few minutes or several days, affords 168 to 170 parts of dry *pyroxyline*.

Xyloidine as long since determined by Pelouze, consists of one equivalent of starch in which one equivalent of nitric acid has replaced the elements of one of water.

Pyroxyline has been found by the same chemist to consist of cellulose, with the addition of two equivalents of mono-hydrated nitric acid and the removal of one equivalent of water, giving the formula $C^{12}H^{9}O^{9}$, $2NO^{5}$, 2HO, or without hypothesis $C^{12}H^{11}O^{21}N^{2}$.

According to the late investigations of T. Ransome, (Phil. Mag., Jan., 1847,) the composition of gun-cotton is expressed by the formula $C^{12}H^{9}O^{20}N^{2}$; and it results from common cotton by the removal of two atoms of hydrogen, and the addition of two atoms of nitric acid. Explosion produces carbonic oxyd, water and nitrogen, and no nitrous acid. Messrs. Porrett and Teschemacher have shown that cyanogen also is produced. The editors of the Philosophical Magazine suggest, that Mr. Ransome's results may be a consequence of combustion at a lower temperature than is required for the combination of nitrogen and carbon.

Pelouze states that in France the cost of 170 kilogrammes of gun-cotton (exclusive of labor) will be 317 francs, (the cotton 200, the nitric acid 100, and the sulphuric acid 17 francs.) The gun-paper will be still cheaper; made from paper pulp, the cost will be, he says, about 97 francs for 100 kilogrammes, excluding the cost of labor.

Unprepared cotton becomes explosive when dipped in a strong solution of chlorate of potash; and the force of gun-cotton is increased by immersing it after preparation in a similar solution.

The gun paper is to become an important material in pyrotechnics. Dipped in solutions of nitrate of strontia, sulphate of copper, nitrate of baryta, it has afforded fine red, green and white lights. The combustion is rendered slow by the immersion in metallic salts, which is highly favorable for pyrotechnic purposes.

This material is also valuable for the manufacture of percussion caps, and bids fair to supplant other fulminating compounds for this purpose, on account of the safety and cheapness of its preparation.

15. *Arsenic in Mineral Waters;* (L'Institut, No. 670, Nov. 4, 1846.)—Arsenic has been found, by M. Valchner, in various mineral waters at Viesbade in Germany, and this has been confirmed by M. Figuier. The last mentioned chemist has ascertained that the arsenic is in the state of arsenous acid, and that the proportion is nearly 0·045 grammes for 100 litres of the water. He detected no arsenic in the waters of Passy.

16. *On Fluorine;* by M. Louyet, (L'Institut, No. 673, Nov. 25, 1846.)—M. Louyet concludes from his researches that fluorine is a colorless gas, possessing odor, having the power of bleaching vegetable

colors, decomposing water at the ordinary temperature in the light, attacking glass feebly if at all, acting upon almost all the metals but not attacking gold or platina, or at least, not except in the nascent state. His experiments on the equivalent of fluorine, fix it at 239·81. He finds that it presents stronger analogies with oxygen and sulphur, than with chlorine, bromine, and iodine, and the allied bodies.

17. *Silica*, (L'Institut, Dec. 2, 1846, No. 674.)—M. Kopp offers several reasons for considering SiO^2 the formula of silica, instead of SiO^3. They are based on the following considerations;—1, the density and relation of volume of the compounds of silicium and boron, as compared with chlorine and fluorine; 2, the density of the vapors of the silicic ethers; 3, analogies between silicic, titanic, and tantalic acids; 4, simplicity of composition of the fluo-silicates; 5, the more simple formulæ for the most of the silicates; 6, the augmentation of the number of the simple and neutral silicates, adopting the formula SiO^2; 7, diminution of the great basicity of the silicates, which seems to have little relation with the comparative feebleness of the acids; 8, a new and much more general classification of the family of feldspars.

18. *Nitrification*, (L'Institut, Dec. 2, 1846, No 674.)—M. Dumas states that when a current of moist air containing ammonia is directed upon a solution of potash, the temperature being at 100° C., a quantity of nitrate of potash is formed through a change of the ammonia into nitric acid. He remarks that this experiment, which accords with the labors of M. Kuhlmann on nitrification, was suggested to him by observations which he had recently made upon the conversion of sulphuretted hydrogen into sulphuric acid.

19. *Phosphate of Lime in Organic Beings*, (L'Institut, Dec. 2, 1846, No. 674.)—M. Dumas attributes the disaggregation of bones on exposure in the soil, and the removal of the phosphate of lime by water, to two causes, the one of feeble intensity and acting rarely, the other of great force and always in action. The first depends on the *ammoniacal* salt in waters, which salt enables them to dissolve phosphate of lime; this salt is every where present, but in so small a quantity as to have comparatively little influence. The second depends on carbonic acid, which appears to be the true solvent of phosphate of lime; for waters charged with carbonic acid, dissolve large quantities of it. Alkalies and ebullition separate the carbonic acid and precipitate the salt. The action of this acid is so powerful that shavings of ivory placed in a bottle of seltzer water, are softened in twenty-four hours as if in chlorohydric acid; and the seltzer water contains, afterwards, all the phosphate of lime contained in the ivory. This property, adds Dumas, enables us to understand the introduction of phosphate of lime into plants. These facts explain the disaggregation of bones, and the dissemination of the phosphate of lime in the soil through the carbonic acid contained in rain waters; they show how, in the animal economy, bones may be redissolved by the venous blood charged with carbonic acid; they indicate the part which the fluorid of calcium acts in the teeth, in protecting the osseous portion from the carbonic acid disengaged from the lungs, and dissolved also in the saliva, which at the same time is alkaline to neutralize the action of the acid. Dumas suggests the use of carbonated waters for persons affected with calculi of phosphate of lime.

20. *On Elliptic Polarization;* by Mr. DALE, (Proc. Brit. Assoc., from Athen, Sept. 19, No. 986.)—The paper which I have to read to the Section, relates to some new observed facts in the subject of elliptic polarization, which appear to point out the physical element on which depends the different action of metals on light, as compared with transparent substances in general. They have already been communicated to the Ashmolean Society at Oxford, but I have been induced to bring them forward at present, with a view of more readily gaining for them the notice of those interested in optics. This peculiar action, it will be remembered, is of this kind: first, that the metals (and metallic sulphurets, &c.) have no angle of complete polarization for common light; and secondly, that a plane polarized ray becomes elliptically polarized after reflexion from their surfaces, whereas it remains plane polarized after reflexion from glass and such like bodies. Endeavors have naturally been made to account for these phenomena on the principles of the undulatory theory; and always, apparently, on the supposition, that the laws of reflexion from transparent (uncrystallized) bodies were already rigorously given by Fresnel's formulæ, but that a new and distinct theory was required for metallic reflexion. Thus assuming that the two classes of phenomena were abruptly separated, without any intermediate links of connexion. It has, indeed, long been known that several transparent or translucent substances have no angle of complete polarization. Thus, Biot (Traité de Physique, iv, 288) has excepted sulphur and the diamond; and Sir John Herschel (Optics, Art. 845; see also 831) excludes from the general rule, besides the metals, those substances which have the adamantine lustre; which term is applied, in Mohs's system of crystallography, to several of the minerals to be presently spoken of, as resembling the metals in another respect. I do not know that any writer, except Mr. Green, (in Camb. Phil. Trans., vol. vi,) has stated this exemption to be general for all substances having a high refractive index; but it is important to recall this experimental fact to our attention, on account of its coincidence and harmony with the new result which I have now to state. It consists in this: that these same highly refractive substances resemble the metals also in a second respect—that they confer elliptic polarization on a plane polarized ray reflected from them. The following list of substances, in which this property was observed, will be found to contain most of those at the top of Sir D. Brewster's list of refractive indices:—

Indigo—which is remarkable for possessing the metallic lustre without containing any metal.
Artificial realgar.
Diamond—of which three specimens were tried.
Sulphuret of zinc in transparent crystals.
Glass of antimony—translucent.
Sulphur—melted on a polished slip of zinc foil.
Tungstate of lime—transparent.
Carbonate of lead in crystals, clear and limpid as glass.
Hyacinth, or zircon—translucent.
Arsenious acid.
} Garnet.
} Idocrase.
Helvine. Labrador hornblend.

Of which the last five possess the property in a very slight degree only. The test used in every case was the dislocation of the rings of a plate of calc spar; of which a very good specimen was used, capable of exhibiting eight or nine red rings: and all the experiments were made by candle-light, which is indispensable. It will secure greater confidence in these results to say, that all the specimens which I submitted to Prof. Powell's examination, in a different instrument, were found by him to produce the above effect; and from his published observations several more cases may be quoted in confirmation of the general result: such are—chromate of lead, litharge, plumbago, and Indian ink. The natural conclusion from these facts appears to be, that in a perfect mathematical theory of reflexion, both cases should be embraced in one set of formulæ, of which some terms or coefficients should be insensibly small, except when the refractive index was very large; that, *strictly* speaking, no substances *completely* polarize common light at any angle, but that the residue of unaltered light is too feeble to affect the eye, when the refractive index is below a certain limit;—and that plane polarized light always becomes elliptically polarized, but that the virtual difference of paths of the two compact vibrations parallel and perpendicular to plane reflexions is insensibly small, except the refractive index surpass a certain value greater than the refractive indices of felspar and sapphire—which I found to produce no dislocation of the rings. It is remarkable that such formulæ have, some time since, been deduced from a very profound mathematical investigation, by Mr. Green, in the Cambridge Philosophical Transactions, vol. vii;—whose results, however, do not seem to have met with much attention. Now, however, that they have met with the above undesigned general confirmation, it seems very desirable that they should be compared with the numerical results of experiments of Sir D. Brewster and Prof. Powell. Mr. Green adopts, as part of the basis of his calculation, the original view of Fresnel,—that the vibrations of a polarized ray are perpendicular to the plane of polarization; but as this point is a matter of dispute among mathematicians, I have thought of an experimental method by which this point might, as I think, be decided, independently of all theory. It consists in the observation of the shifting of the fringes produced by two pencils of light polarized in the same plane on interposing in their paths a piece of compressed glass. This last apparatus is to be constructed in the following manner:—A strip of clear plate, four or five inches long by half an inch broad, is to be provided; and its narrowest faces (or narrowest long sides of the parallelopiped) are to be carefully polished, and rendered perfectly plane and parallel to each other,—at least, in the middle part of their length, through which the light is to pass. And the glass must be so well annealed and so free from striæ as to allow of the formation of fringes by interfering pencils which have traversed it. It is to be provided with a wooden frame and screw, capable of compressing it in the middle. (A similar apparatus has already been employed by Brewster, Ling and Pouillet, to show that glass under pressure possesses double refraction.) We may now proceed to the experiment itself. Let us suppose, then, that the arrangements have been made in a darkened room for producing the interference of two pencils of light, which are to be polarized in

the same plane, by passing, for example, through the same tourmaline plate. This arrangement might, in fact, be that of Fresnel, in which a slender beam is reflected from two glass plates very slightly inclined, provided that the light were incident at the polarizing angle of glass. And, for the sake of clearness, let us suppose the two foci, or virtual foci, to be vertically one above the other, the plane of polarization to be vertical, and the glass to be interposed with its length horizontal. Then, in its natural state, it will produce no displacement of the fringes, if made carefully after the above description. But let us consider what will be its effect, if interposed in its bent state. The elasticities on its convex and concave sides are different in this respect, that the particles are dilated or compressed *parallel to the length of the glass:* whereas little or no alteration of elasticity is produced in a plane perpendicular to the length of the glass. Hence, if the vibrations of the two polarized pencils are really executed perpendicularly to the plane of polarization, or parallel to the length of the glass, (according to the arrangement above agreed upon,) they will be propagated with different velocities, and the fringes will be displaced parallel to the length of the glass, in a direction which might be inferred from some statements of Sir D. Brewster, but which is quite unimportant to the present purpose. If, however, on the other hand, the vibrations be executed in the plane of polarization, or perpendicular to the length of the glass, the two rays will traverse the glass with almost, or quite, the same velocities, and the fringes will either not be displaced at all, or to a far less amount than in the preceding case.

21. *On certain cases of Elliptic Polarization of Light by Reflexion;* by Prof. Powell, (Proc. Brit. Assoc., from Athen., Sept. 19, No. 986.) —From the principle investigated by Fresnel, that polarized light changes its plane, in reflexion, by a certain law dependent on the incidence (from transparent media) and the extension of a similar law to reflexion from a second surface, by Sir D. Brewster, (Phil. Trans. 1830, p. 148,) other formulæ were obtained by the last named philosopher to express the varied phenomena observed by himself (Phil. Trans. 1841) in the reflexion of polarized light from thin films, in extension of those previously investigated by Mr. Airy and M. Arago. The whole subject was reduced to the principles of the undulatory theory by Dr. Lloyd, (see Brit. Assoc. Report, 1841, Sect. proceedings, p. 26,) who pointed out the further theoretical result that, owing to the difference of phase or retardation thus produced in the two portions into which the reflected light is divided, polarized light reflected by a thin plate will, in general, become elliptically polarized. It is certain, however, that, in a great number of cases of thin plates examined by the author of this communication, no ellipticity can be detected. Glass superficially decomposed and giving brilliant tints produces no ellipticity, except in those instances where it has a decided *metallic* lustre. Vapor condensed on soaped glass, (in the manner described by Sir D. Brewster,) oil of turpentine, cassia, &c. between glass plates, (the upper being slightly prismatic, to separate the reflexions,) are equally without effect. The theory, therefore, clearly needs some further modification to express the conditions under which the effect may be sensible. There are, doubtless, many cases of thin plates in which elliptic polarization

is produced, as in the films formed on metallic plates by Nobili's process, and by heat, as investigated by the author of this communication: or, again, as in mica which has become laminated, &c. But in these cases the *modus operandi* is well understood;—in the former, from the enormously high refractive power, and in the latter from the crystalline structure. In the case of China ink observed by the author, the ellipticity appears equally, whether it be in the form of a film or in a solid mass—though it is only seen in the purest specimens. In the numerous other cases examined by Mr. Dale, it does not appear that any thing like films can be supposed; the only condition seems to be the high refractive power. It may still be a question, then, whether the theory proposed independently by M. Cauchy and by Mr. Tovey be not more easily applicable,—since it requires nothing but the very simple and admissible hypothesis, that the *molecules of æther*, for a minute depth within the surface, are *unsymmetrically distributed*. (See the author's treatise on the Undulatory Theory applied to Dispersion, &c.) In various substances containing but a very small proportion of metal, ellipticity has been detected, in addition to those enumerated by the author on a former occasion. Among these are Prussian blue, and the meteorite from the Cape of Good Hope, described in the Philosophical Transactions, 1839 and 1840,—which contains only about 33 per cent. of protoxyd of iron, very small portions of oxyds of nickel and chrome, and a trace of metallic iron, (see Phil. Trans. 1829, i, 86.)

II. Mineralogy and Geology.

1. *Analysis of the American Mineral Nemalite;* by Prof. Connell, (Proc. Brit. Assoc., from Athen., Sept. 26, No. 987.)—This mineral bears a striking resemblance to asbestus, so that by the eye it can hardly be distinguished from it. It was first chemically examined by Mr. Nuttall, who ascertained that it differs entirely in constitution from asbestus, and concluded, from his experiments, that it consists essentially of magnesia and water, with a little oxyd of iron and lime. It was subsequently examined by Dr. Thomson, according to whom it also contains 12½ per cent. of silica. The constituents found by the latter were—

Magnesia,	51·721
Silica,	12·568
Peroxyd of iron,	5·874
Water,	29·666
	99·829

The result which I have obtained differs somewhat from both the preceding. According to each of the previous experimenters the mineral is soluble in acids without effervescence. But I have found that even perfectly fresh portions of the specimens which I have of the mineral from Hoboken, in America, sensibly effervesce when dissolved in acids, showing that some carbonic acid is contained in it. I have also found only a very minute quantity of silica, the mineral leaving scarcely any residue when dissolved. The amount of water was determined by ascertaining the quantity of water collected by ignition in a tube of German glass twice bent, and containing at one end fused chlorid of

calcium. The carbonic acid was estimated by the loss of weight on treating a portion of the mineral with dilute acid, in a little bottle connected with a tube containing chlorid of calcium. The solid constituents were determined by ordinary methods. The result was—in 100 parts—

Magnesia,	57·86
Protoxyd of iron,	2·84
Silica,	0·80
Water,	27·96
Carbonic acid,	10·
	99·46

Considering the protoxyd of iron as replacing a little magnesia, the mineral appears to be a combination of hydrate of magnesia and hydrated carbonate of magnesia. The formula

$$5\,MgO.\,HO + MgO.\,CO_2.\,HO$$

will nearly express its constitution, and gives—

Magnesia,	61·67
Water,	27·24
Carbonic acid,	11·09
	100·

The native hydrated carbonate of zinc (*zinkblüthe*) is a mineral of analogous constitution.

2. *Reclamation respecting the Identity of Pinite, Chlorophyllite, and other Minerals, with the species Iolite;* by CHARLES UPHAM SHEPARD, M. D.—In a paper by Mr. W. Haidinger published in Pogg. Annal., 1846, lxvii, 441, (and referred to in the last volume of this Journal, p. 418,) wherein the identity above mentioned is fully treated, the writer has overlooked an article by myself, published in 1841, Vol. xli, p. 354, of this Journal, entitled "*On two decomposed varieties of Iolite.*" Those varieties were the *Pinite* of Haddam, Ct., and the *Chlorophyllite* of Dr. Jackson. Mr. Haidinger appears also to have been unacquainted with the fact that the 2d edition of my Treatise on Mineralogy, (New Haven, 1844,) refers, (p. 141,) not only both of the above varieties to Iolite, but likewise the *Gigantolite*, the *Fahlunite*, the *Esmarkite*, and the *Hydrargillite* of Rose, to the same species.

New Haven, Oct. 30, 1846.

There is this difference between the results of M. Haidinger and Prof. Shepard: the latter described the minerals above referred to as *decomposed* iolite and *varieties* of that species; while the former speaks of them as mineral species (with chemical formulas) resulting from the *alteration* of iolite. The change is dependent on chemical affinities; and another species may be formed as much as when pseudomorphous specular iron is derived from magnetic iron.*—EDS.

* "To the foregoing remark of the Editors, Prof. Shepard wishes to add, that what he claims is simply to have first pointed out the relation between the above mentioned substances (chlorophyllite, pinite, &c.,) and iolite, analogous to that which is admitted to exist between Rensselaerite and pyroxene, or the greenish grey talcy crystals from Amity (called pseudolite by Nuttall) and spinel. If Mr. Haidinger or any other mineralogist thinks it proper to construct chemical formulas for those decomposed or altered minerals, and to introduce such minerals as species, possessing a coördinate natural history value with iolite itself, Mr. Shepard by no means puts in a claim of priority as regards such labors."

3. *Chiolite, a new mineral from Miask;* by Fr. v. Wörth, (Verhandl. Min. Ges. zu St. Petersburg, 1845–46.)—Chiolite is a massive mineral resembling cryolite. It occurs granular, with a shining lustre, and presenting a grayish, yellowish, or snow white color. The streak is snow white. The hardness is between calc spar and fluor spar. Specific gravity of the masses 2·6209; of the powder 2·770. The structure of the massive pieces is imperfectly foliated, and the surface of foliation exhibits a lustre between greasy and vitreous. The specimen examined by M. Wörth, indicated that it was associated with lithia mica, massive fluor spar, and quartz. It melts easily in the flame of a candle, but at first decrepitates. Its transparency increases in water.

According to the chemical analysis of A. Chodnew, it consists of aluminium 16·48, sodium 25·72, potassium 0·58, magnesium 0·76, yttrium 1·04, fluorine 56·00=100·38, giving the formula $2\mathrm{Na\,F} + \mathrm{Al\,F_3}$. Cryolite differs in containing, for the first term, 3Na F, and also in its higher specific gravity. The name chiolite is from the Greek word for snow.

4. *On the alleged Coëxistence of Man and the Megatherium;* by C. Lyell, (addressed as a letter to the Editor of the Times, and published in the Times of Dec. 8, 1846.)—Sir: A considerable sensation appears to have been caused in the minds of the scientific, and part of the unscientific public, by the announcement in many of the newspapers of the discovery in America of a fossil human bone associated with the remains of the megatherium and other extinct quadrupeds. I have only just read in the last number of the Athenæum, (December 5, 1846,) a brief notice of the reported discovery, copied from an American paper, and which the editor has inserted with a judicious caution to his readers that no competent authority has yet vouched for all the facts. I feel sure that the story relates to part of a human pelvis (a fragment of the *os innominatum*) which was shown to me at Natchez last spring, together with several very remarkable remains of megatheroid animals. I visited Natchez in March last, on which occasion I was informed of the antiquity assigned to the human relic, and having examined carefully into the evidence, came to the conclusion that the proofs of the coëxistence of the human individual with the megatheroid and other extinct quadrupeds found in the vicinity was altogether unsatisfactory. We are indebted to the skill and indefatigable industry of Dr. Dickerson of Natchez, for having formed a splendid collection of organic remains, derived from the superficial deposits of that neighborhood. All these he had the kindness to show me, and afterwards accompanied me to the principal spots where they had been procured. One of these, distant about six miles from Natchez, has been named by him the Mammoth ravine, from the skeleton of the mastodon discovered there; and it was there also that the fragment of the human pelvis, supposed to have been contemporaneous with the megatherium, was picked up.

In order to explain its position, a few words on the geology of the region will be indispensable. The broad, flat, alluvial plain of the Mississippi is bounded on its eastern side by a table-land about two hundred feet higher than the river, and having a very gentle upward slope to the eastward or towards the interior. This elevated platform ends abruptly at Natchez, in a line of perpendicular cliffs, or bluffs, the base of which is continually undermined by the Mississippi. The vertical sec-

tion here exposed to view affords the geologist a fine opportunity of studying the composition and succession of the strata for a vertical thickness of rather more than two hundred feet. The whole deposit is of comparatively modern date, the upper sixty feet consisting of clayey loam, containing shells of recent species, and the lower of sand and gravel without organic remains, except some wood and silicified corals washed out of older rocks. The yellow loam at the top bears a singularly close resemblance to the fluviatile silt, or "loess," as it is termed, of the valley of the Rhine, between Cologne and Basle, and, like it, contains abundance of freshwater and land shells, of which I myself obtained more than twenty species, now in my cabinet in London. They belong to the genera Helix, Helicina, Pupa, Succinea, accompanied or rather replaced in a few places where the loam passes into shell-marl, by Lymnea, Planorbis, Physa, and Cyclas. All the species are identical with testacea, now inhabiting the same part of the United States. With these shells are found, at different depths, some in the loam, and some in the clay at the bottom of the loam, the scattered bones and occasionally entire skeletons of the mastodon, megatherium, mylodon, casteroides, equus, bos, and other quadrupeds. If in any part of this formation, whether at the depth of ten feet or one hundred, any remains of man lie buried by natural causes in undisturbed loam or clay, the antiquity of the human race is thereby established to an extent far greater than has ever yet been made out in any instance which I have had an opportunity of investigating. It would follow that the human race had survived the extinction of one group of terrestrial mammalia and seen another succeed and replace it; and also that man had lived in North America when the geographical configuration of the country was very different,—in other words before the valley of the Mississippi, or even some of the strata forming its boundary rocks, were in existence. Every deposit entering into the composition of the bluffs of the Mississippi valley must be older than the alluvial plain and delta of that river; and we thus obtain, independently of any evidence attesting great changes in the animate world, a measure for estimating the *minimum* of time which has elapsed since the bluffs originated. For we must allow a sufficient series of years for the deposition of all the sedimentary matter forming the plain and delta of the great river. I have endeavored to calculate the period, (one of enormous duration relatively to the historical epoch,) and explain my views on the subject, in a lecture delivered to the British Association at their meeting at Southampton, and a correct, though incomplete, abstract of that communication appeared in the Atheneum, for Sept. 26, 1846.*

To come then to the point—what proof is there that the geological position of the human pelvic bone was such as to demonstrate its anteriority in date to the entire hydrographical basin of the Mississippi, and the formation of its alluvial deposits and delta? The yellow shelly loam or loess, before mentioned, extends for twelve miles inland or eastward from the river; and in consequence of its incoherent and destructible nature, every streamlet flowing over it cuts out for itself, in its way to the Mississippi, a deep gully or ravine. This denudation has of late years proceeded with accelerated speed, especially in the

* This volume, p. 34.

course of the last thirty or thirty-five years. Some attribute the increased erosive action to partial clearings of the native forest; others to the effects of the great earthquake of New Madrid in 1811–12, by which this region was much fissured, ponds being dried up, and some landslips caused. Colonel Wiley, a proprietor in this part of the state of Mississippi, and who well remembers the district before the year 1812, assured me that the Mammoth ravine although now seven miles long, and in some parts sixty feet deep, with its numerous ramifications, has been entirely formed since that year when the earthquake occurred. He has himself ploughed some of the land exactly over the spot where the ravine is now situated.

It is however enough for our purpose to affirm that whatever be the date of the origin of this watercourse, it has of late years been considerably enlarged and lengthened, its banks presenting everywhere precipices in which the loam, unsolidified as it is, retains its verticality, as is the case with its counterpart, the loess of the Rhine. Land shells are seen in great numbers at the depth of about thirty feet from the top, and the fossil bones of the mastodon, and other extinct quadrupeds, are usually picked up in the bed of the stream, after they have been washed out of the undermined cliffs, where, however, some few have also been observed *in situ*. Under these circumstances, as I was given to understand, the human pelvis was procured at the base of the cliff. Even if it had been dug out in the presence of a practical geologist, it would have been necessary for him to be more than usually on his guard against deception, for landslides have detached large masses from the cliffs, and these may easily cover human bones previously washed down by the stream or dislodged from the soil near the top of the cliff, where some old Indian graves, so common throughout the country, may have been undermined. It is not rare to find on shoals and on the shores of the islands in the Mississippi at low water, numerous bones of man mingled with those of extinct animals washed out of the bluffs. In these cases the human bones are as black as the quadrupedal fossils, having been apparently stained with peaty matter, in the soil where they were buried; but no geologist has ever ventured on this evidence, to infer the contemporaneousness of man and the fossil specimens thus accidentally associated.

After I had made up my mind that the remote antiquity of the human bone at Natchez was questionable, and that its occurrence in the ravine might be explained in the manner above suggested, I found that Colonel Wailes, a friend of Dr. Dickerson's, who accompanied us in part of our excursion, and who has also made a fine collection of the fossils of this neighborhood, not only shared my doubts, but had made the same conjecture respecting the probable manner in which the fossil may have been conveyed to the spot where it was found. I have the honour to be, Sir, yours, &c., CHARLES LYELL.

11, Harley street, Dec. 7.

5. *Notices of the Superposition of certain Minerals in some of the Metalliferous Deposits of Cornwall and Devon;* by WILLIAM JORY HENWOOD, F. R. S., F. G. S., Chief Commissioner of the Gongo Soco and Catta Preta Gold Mines, (from the L., E. & D. Phil. Mag., Nov., 1846, xxix, 359.)—The interesting communications of Messrs. Fox and Dana, induce me to present an abstract of observations on the superpo-

sition of certain minerals, made during my examination of the mines of Cornwall and Devon.

To enumerate all the substances of which the *lodes* in that district are composed and their respective localities, would be a tedious task, and at present perhaps not a very useful one: I have therefore tabulated the order in which only the more abundant of them occur. The nature of the (*country*) containing rock is prefixed:—the first column denotes the mineral adjoining the (*wall*) side of the *lode;* the second, that which rests on that named in the first; the third, the substance overlying the second, and so on: the last column contains the names of some of the localities. The italic letter denotes the crystalline; the Roman, the massive minerals.

Mineral adjoining *wall* of *lode*.	Mineral resting on that in first column.	Mineral resting on that in second column.	Mineral resting on that in third column	Localities.
Containing rock—Granite.				
Quartz	*Quartz*			Numerous.
Quartz	Opal	Chalcedony		Wheal Cairn.
Quartz	*Quartz*	*Arseniate of iron*		Pedn-an-drea.
Quartz	*Quartz*	*Wolfram*		Wheal Gorland.
Quartz	*Quartz*	*Arseniate of copper*		St Michael's Mount.
Quartz	*Quartz*	*Uranite*		Wheal Unity.
Quartz	*Oxyd of tin*	*Tungstate of lime*		Gunnis Lake.
Quartz	Native copper	*Red oxyd of copper*		Wheal Friendship.
Quartz	*Malachite*			Wheal Gorland.
Quartz	Mineral pitch			Gunnis Lake.
Amethystine quartz	Quartz			East Wheal Crofty.
Amethystine quartz	*Amethystine quartz*			Wheal Bellon.
Felspar	Phosphate of iron			Dartmoor.
Fluor	*Fluor*	*Quartz*		Park-noweth.
Oxyd of tin				Wheal Gorland.
Oxyd of tin	*Sulphuret of bismuth*			All tin mines in granite.
Hematite iron ore	*Specular iron ore*			Balleswidden.
Earthy brown iron ore	*Vitreous copper ore*	Black copper ore		Park-noweth.
Earthy brown iron ore	*Red oxyd of copper*			Wheal Jewel.
				Wheal Gorland.
Containing rock—Greenstone.				
Quartz	Stalactitic quartz.	*Quartz*		Wheal Edward.
Quartz	*Quartz*	*Arragonite*		Levant.
Quartz	*Quartz*	*Hydrous oxide of iron*		Restormel.
Quartz	*Quartz*	*Wolfram*		Poldice.
Quartz	*Quartz*	*Arseniate of copper*		Wheal Unity.
Quartz	*Quartz*	*Arseniate of lead*		Wheal Unity.
Quartz	Chlorite	*Oxide of tin*		Wheal Vor.
Quartz	Chlorite	*Arseniate of lead*		Wheal Unity.
Quartz	Fluor	*Fluor*		Wheal Unity Wood.
Quartz	Arsenical pyrites	*Arsenical pyrites*		Wheal Unity Wood.
Quartz	Earthy brown iron ore	*Phosphate of copper*		Gunnis Lake.
Quartz	Earthy brown iron ore	Pitch-blende		Wheal Edward.
Quartz	Earthy brown iron ore	*Uranite*		Wheal Edward.
Quartz	Earthy brown iron ore	Vitreous copper ore		Botallack.
Quartz	Carbonate of iron	*Spathose iron ore*		Botallack.
Quartz	Vitreous copper ore	*Arragonite*		Levant.
Quartz	Chlorite	Copper pyrites	Mineral pitch	North Roskear.
Containing rock—Felspar porphyry (Elvan).				
Oxyd of tin	Oxyd of tin			Wherry.
Silicate of tin				Wheal Coates.
Quartz	Earthy brown iron ore	*Blue carbonate of copper*		Ting Tang.
Quartz	Earthy brown iron ore	*Malachite*		Ting Tang.
Quartz	Copper pyrites			Ting Tang.
Earthy brown iron ore	Copper pyrites			Ting Tang.
Earthy brown iron ore	Native copper			Wheal Buller.
Earthy brown iron ore	Vitreous copper ore			Ting Tang.
Earthy brown iron ore	*Red oxyd of copper*			Ting Tang.
Earthy brown iron ore	*Arseniate of copper*			Ting Tang.
Earthy brown iron ore	Crysocolla			Ting Tang.

Mineral adjoining *wall of lode.*	Mineral resting on that in first column.	Mineral resting on that in second column.	Mineral resting on that in 3d column.	Localities.
		Containing rock—CLAY-SLATE.		
Quartz	*Quartz*	*Quartz*		Wheal Friendship.
Quartz	*Quartz*	*Copper pyrites*	*Quartz*	East Crinnis.
Quartz	*Quartz*	*Sulphate of barytes*		United Mines.
Quartz	*Quartz*	Copper pyrites	*Copper pyrites*	United Hills.
Quartz	*Quartz*	*Sulphuret of antimony*		Pengelly.
Quartz	Chlorite	Oxyd of titanium		Virtuous Lady.
Quartz	*Quartz*	*Blende*	*Fluor*	Polberrow.
Quartz	*Quartz*	*Celestine*		Binner Downs.
Quartz	Fluor	Galena		Wheal Penrose.
Quartz	Iron pyrites	*Quartz*		West Pink.
Quartz	Iron pyrites			Numerous.
Quartz	Iron pyrites	Carbonate of iron	*Spathose iron ore*	Virtuous Lady.
Quartz	Iron pyrites	*Phosphate of iron*		Wheal Falmouth.
Quartz	Iron pyrites	Sulphuret of silver		Dolwath.
Quartz	Earthy brown iron ore	*Red oxyd of copper*		Wheal Charlotte.
Quartz	Earthy brown iron ore	*Carbonate of lead*		Penture-glaze.
Quartz	Earthy brown iron ore	*Phosphate of lead*		Wheal Alfred.
Quartz	Earthy brown iron ore	*Sulphate of lead*		Mellanear.
Quartz	Hematite iron ore	Oxyd of manganese		Restormel.
Quartz	*Wood tin*			Polberrow.
Quartz	*Oxyd of tin*			Numerous.
Quartz	Native silver			Herland.
Quartz	Sulphuret of silver			Wheal Brothers.
Quartz	*Red silver ore*			Dolcoath.
Quartz	Native copper			Numerous.
Quartz	Vitreous copper ore	*Vitreous copper ore*		Wheal Speed.
Quartz	Vitreous copper ore	*Capillary red oxyd of copper*		Providence.
Quartz	*Buntkupfererz*			Wheal Falmouth.
Quartz	Copper pyrites			Numerous.
Quartz	Copper pyrites	*Sulphuret of bismuth*		Fowey Consols.
Quartz	*Tennantite*			Fowey Consols.
Quartz	Copper pyrites	*Fluor*		Polberrow.
Quartz	*Red oxyd of copper*			Numerous.
Quartz	Galena	*Galena*	*Quartz*	Wheal Rose.
Quartz	*Blende*	Pearl-spar		Union Mines.
Quartz	*Blende*	*Fluor*		West Pink.
Quartz	*Galena*	*Blue lead ore*		Wheal Hope.
Quartz	Blende	*Blende*		Union Mines.
Quartz	Mineral pitch			South Towan.
Quartz	Carbonate of lime			Binner Downs.
Chlorite	*Oxyd of tin*			Numerous.
Pearl-spar	*Copper pyrites*			Cann Quarry.
Fluor	Copper pyrites			Wheal Unity Wood.

As the foregoing table is a first attempt at arranging these facts, it will doubtless be found susceptible of many improvements.

For the present I abstain from mentioning inferences, though many are obvious enough.

6. *Geological Society of France*, (L'Institut, Dec. 2, 1846, No. 674.)—The *Reunion Extraordinaire*, at Alais, commenced on the 30th of August. On the first day a memoir was read by M. l'Abbé Chamousset, on the mineralogical and geological productions of Alais, and another by M. J. Teissier, on the means of introducing water into the village of Alais. On the next day, the Society commenced their scientific explorations; they first examined the dolomite and lias of the vicinity, the Oxford formation of Mount Hermitage, and the contact of the *keuper* and the coal formation near Provençal and elsewhere; they examined the latter beds from Rochebelle to the bridge of Tamaris, and ended by visiting the great iron founderies and forges of the region. The 1st of September, they examined the coal basin of Alais through a great part of its extent, which exhibits extensive foldings and dislocations. M. Emelien Dumas read, on this occasion, a detailed memoir accompanied

with plates, on the coal basins of Bessèges and Alais. M. J. de Malbos read a memoir on a fossil plant of the green sand, before found in other formations by MM. Faujas de Saint Fond and Dunoyer. The 2nd of September was occupied by a continuation of the coal explorations. The 3d was devoted to an examination of the lacustrine formation and neocomian limestone on the route by Méjanes, Saint-Hyppolyte-de-Caton, Euzet; a marly limestone, in the lower part contains menilites, fossil fish, insects and vegetables.

7. *Volcanic Dust of Hecla;* by Dr. TRAILL, (Proc. Roy. Soc., Edinb., ii, 56, Dec. 1845.)—Dr. Traill read an account of dust falling from the atmosphere on the 2d and 3d of September last, in the islands of Orkney.

This dust was observed by a gentleman in the island of Rousay, falling from the air on the morning of the 2d. It was collected by another at Skaill, on the western shores of Pomona, on the morning of the 3d; and by two other gentlemen in Kirkwall on the same day. It appears also to have fallen in several other parts of Orkney, probably over all the islands; and was observed also to reach the northern coasts of Caithness, within an area of which the radius cannot be less than 30 or 40 miles.

It covered, to the depth of from $\frac{1}{12}$ to $\frac{1}{6}$ inch, linen laid out to dry, glass frames in gardens, and the leaves of plants of every kind, with a fine brownish-grey dust, almost impalpable to the touch, but meagre and grinding between the teeth. It does not effervesce with acids, and consisted chiefly of silex, alumina, oxyd of iron, with a trace of lime.

This dust bears much resemblance in composition and appearance to that which covered the decks and rigging of vessels in the West Indian seas, when the eruption of the Soufrière took place in St. Vincent, in 1812. Those who collected the dust in Orkney, state the probability that it proceeded from some eruption of Hecla, as the ashes of that volcano *once* before fell in Orkney; and the wind for several days before the 2d of September had blown strongly from the N. W.

The truth is, that such an occurrence has at least three times before happened in the Orkney and Zetland Isles, when there has been an eruption in Iceland. In 1755, during a violent eruption of the Köttlugiær Jökul, showers of ashes fell in the Zetland isles. In 1766, during a great eruption of Hecla, showers of ashes reached the Orkneys, and were long remembered there under the name of the *black snow*. Again, in 1783, a similar dust was observed to descend in Orkney, which was coincident with a terrible eruption of the Shaptär Jökul; the most calamitous which ever happened in Iceland.

Thus, the volcanic ashes of that island have thrice before reached our northern islands; and recent intelligence brought by Danish fishing vessels from Iceland announces, that, in the end of August, after being quiescent since 1766, Hecla has emitted a violent eruption from its flanks; and there can be little doubt that the dust now exhibited is derived from that eruption.

The distance between Hecla and the Orkney Islands is about 550 miles. Volney and other writers assure us that the ashes of Etna are often carried to the plains of Egypt, or to double that distance; and

the eruption of the Tomboro, as described by Raffles, in the eastern archipelago, appears to have exerted a no less astonishing projectile force.

8. *Volcano in the Red Sea;* (Athen., Nov. 28, No. 996.)—A despatch has been received at Lloyd's from the East India House, inclosing a copy of a letter from Lieut. Barker, of the Hon. East India Company's steam-vessel Victoria, announcing that on the 14th of August last, smoke was observed to issue from the summit of Saddle Island, in lat. 15° 7′ N., long. 42° 12′ E. The weather, at the time, was very squally, with thunder and lightning. Saddle Island is one of a group called Zebayer Islands in the Red Sea; in the direct track of vessels proceeding up and down. They are all of volcanic origin, but there is neither record nor tradition of their having been in active operation. Jibble Seer, in lat. 15° 32′ N., and long. 41° 55′ E., was observed to be smoking when visited by the officers of the Benares during the survey of the Red Sea,—but never since. There is a tradition among the Arab pilots of its having been on fire some fifty years ago; and it bears among many of them the name of Jibble Dookhan, or Hill of Smoke,—and has the appearance of having been in active operation at a much later period than the Zebayer Islands.

9. *Probable Submarine Volcano*, (Athenæum, Dec. 26, No. 1000.)—The ship Helena on her late passage from Batavia to Canton, when in latitude 16° N., long. 125° E., fell in with immense fields of floating pumice stones, apparently not having been long erupted, many of which were as large as a common bucket. The nearest land to windward was the Ladrones, about 1000 miles distant. It seems impossible that they could have come from thence—nor could they have come from Luzon, dead to leeward.

10. *Coal on the Rocky Mountains, discovered by Capt. Frémont;* by James Hall, (Frémont's Expedition, p. 297.)—A few miles up Muddy river, (long. 111°, lat. 41½°,) Captain Frémont collected a beautiful series of specimens of fossil ferns. The rock is an indurated clay, wholly destitute of carbonate of lime, and would be termed a "fire clay." These are probably, geologically as well as geographically, higher than the oolite specimens, as the rocks at this place were observed to dip in the direction of N. 65° W. at an angle of twenty degrees. This would show, conclusively, that the vegetable remains occupy a higher position than the oolite. Associated with these vegetable remains, were found several beds of coal, differing in thickness. The section of strata at this place is as follows:

	Ft.	In.
Sandstone, ...	1	0
Coal, ...	1	3
Coal, ...	1	3
Indurated clay, with vegetable remains, .	20	0
Clay, ...	5	0
Coal,		
Clay, ...	5	0
Coal,		
Clay, ...	5	0
Coal,		

The stratum containing the fossil ferns is about twenty feet thick; and above it are two beds of coal, each about fifteen inches. These are succeeded by a bed of sandstone. Below the bed containing the ferns, there are three distinct beds of coal, each separated by about five feet of clay. Before examining the oolitic specimens just mentioned, I compared these fossil ferns with a large collection from the coal measures of Pennsylvania and Ohio, and it was quite evident that this formation could not be of the same age. There are several specimens which I can only refer to the *Glossopteris Phillippsii*, (see description,) an oolitic fossil; and this alone, with the general character of the other species, and the absence of the large stems so common in the coal period, had led me to refer them to the oolitic period. I conceive, however, that we have scarcely sufficient evidence to justify this reference; and though among the fossil shells there are none decidedly typical of the oolite, yet neither are they so of any other formation; and the lithological character of the mass is not reliable evidence. Still, viewed in whatever light we please, these fossil ferns must, I conceive, be regarded as mostly of new species, and in this respect form a very important addition to the flora of the more modern geological periods.

III. Botany and Zoology.

1. *The Characters of some New Genera and Species of Compositæ from Texas;* by Asa Gray, M. D., (from the Proc. of the Amer. Acad. of Arts and Sciences, Dec., 1846.)

Genus Lindheimera, *Gray & Engelm., Pl. Lindh. ined.* (Senecionideæ-Melampodineæ.)

Capitulum multiflorum monoicum; fl. radii 4–5 ligulatis, fœmineis, ad axillas squamarum invol. interiorum sitis; fl. disci circiter 20 tubulosis, sterilibus. Involucrum duplex, exterius e squamis 4–5 laxis linearibus foliaceis, interius totidem membranaceo-foliaceis oblongis planis disco longioribus. Receptaculum planum, paleis chartaceis ovariis sterilibus amplectentibus onustum, binis exterioribus basi cujusque squam. inter. invol. adnatis, persistentibus. Ligulæ ovales, breviter tubulatæ, involucrum vix superantes: corolla disci 4–5-dentata. Styli fl. ster. filiformes, indivisi, hispidi. Achænia radii ovalia, obcompresso-plana, marginato-alata, intus subcarinata, carina apice in dentem parvum reflexum producta, alis in pappum 2-dentatum extensis; disci abortivi.—Herba erecta, scabro-hispida, forte biennis; caule dichotomo; pedunculis subcymoso-paniculatis gracilibus monocephalis; foliis imis alternis, cæteris oppositis sessilibus oblongo-ovatis basi dentatis, summis pedunculisque glandulis patelliformibus conspersis. Flores aurei.

L. Texana.—In rupestribus sylvis circa New Braunfels, Texas, *Lindheimer.*—Genus eximium, Berlandieræ et Engelmanniæ cognatum, diximus in honorem ejus acerrimi inventoris qui floram Texanam largiter indagavit.

Genus Barrattia. *Gray & Engelm., Pl. Lindh. ined.* (Senecionideæ-Helianthеæ-Euhelianthеæ.)

Capitulum multiflorum heterogamum; fl. radii ligulatis (circ. 10) neutris, disci tubulosis hermaphroditis. Involucrum imbricatum triseriale, squamis lanceolatis apice herbaceis disco brevioribus. Recepta-

culum convexum, paleis navicularibus persistentibus achænia amplectentibus. Corolla fere Helianthi. Styli rami elongato-subulati, hispidi. Achænia compresso-plana, emarginato-obcordata, glabra, immarginata, calva.—Herba valida perenni, strigosa, corymboso-ramosa; foliis omnibus oppositis deltoideo-ovatis vel subhastatis inciso-dentatis triplinerviis petiolatis, petiolis basi appendicibus foliaceis interpositis connatis; pedunculis solitaris elongatis monocephalis. Flores radii et disci flavi.

B. calva.—In rupestribus prope originem flum. Guadaloupe, Texas, *Lindheimer.*—Genus a Leighia diversa pappo plane nullo, ab Encelia achæniis non comosis, a Wulfia achæniis compresso-planis, etc., diximus in honorem Josephi Barratti, M. D., botanici inclyti, Salicum præcipue indagatoris.

It may be proper to append here the characters of another unpublished Helianthoid genus, which is even more closely allied to Encelia (although well distinguished by its pappus), and is also analogous to Agarista.

Genus GERÆA, *Torr. & Gray, Fl. N. Amer. ined.*

Capitulum multiflorum heterogamum; fl. radii (circ. 15) ligulatis, neutris, disci tubulosis hermaphroditis. Involucrum laxe imbricatum 2–3 seriale, squamis lineari-lanceolatis herbaceis. Receptaculum planum, paleis hyalinis oblongis achænia semi-amplectentibus deciduis onustum. Ligulæ cuneiformes, basi pilosæ: corolla disci fauce dilatato-cylindrica e tubo brevi villoso, 5-dentatæ. Styli rami in appendicem lineari-filiformam hispidam longe producti. Achænia oblongo-cuneiformia, plano-compressa, marginata, pilis argenteis prælongis (ad margines præsertim) villosissima. Pappus bisquamellatus, squamellis ex marginibus achænii ortis lineari-aristiformibus basi villosissimis corollam adæquantibus.—Herba annua? hirsuto cana; caulibus basi foliatis (foliis obovatis rhombeisve alternis) superne nudis subpaniculatis pedunculos paucos 1–2-cephalos gerentibus. Involucrum cano-villosum. Flores radii discique flavi.

G. canescens.—California, *Frémont*, *Coulter.* Nomen e γεραιός; ob capitulum canum necnon comam achænii argenteam sumptum, ut contrarium generi analogo Agaristæ, *DC.* (quæ mythologice nympha erat venustissima).

Genus AGASSIZIA, *Gray & Engelm., Pl. Lindh. ined.* (non *Chavan.*, nec *Spach.*)

Capitulum globosum, multiflorum, radiatum; ligulis fœminiis nunc difformibus. Involucrum disco brevius circa biseriale; squamis exterioribus lineari-oblongis, appendicula spathulata vel obtusa foliacea patente, intimis lineari-acuminatis. Receptaculum globosum alveolatum, alveolis valde dentatis fimbrilliferis. Ligulæ cuneatæ, palmato-3–4-fidæ, sæpe irregulares, tubuloso-difformes, vestigia staminum gerentes. Corolla disci Gaillardiæ, dentibus triangulari-lanceolatis. Styli rami ligularum lineares, subulato-apiculati; fl. disci ad basin appendicis brevissimæ nudæ clavato-obtusæ penicellati! Achænia turbinata, sericeo-villosissima. Pappus radii et disci conformis, e paleis 9 hyalinis ovatis uninerviis constans, nervo in aristam capillarem corollam adæquantem longe producto.—Herba biennis, acaulis; radice fusiformi; foliis varie 1–2-pinnatifidis, nunc sinuatis lyratisve; scapo 1–2-pedali toto nudo monocephalo. Capitulum Gaillardiæ, speciosum. Flores suaveolentes, disci flavi et purpurei, radii rubescentes.

A. suavis.—In campis Texanis prope Bexar et New Braunfels, *Lindheimer.*—Genus eximium Gaillardiæ proximum, at ligulis fœminiis, receptaculo globoso vere alveolato, habitu styloque proprio diversum, diximus in honorem celeberrimi amicissimique Agassiz.—Agassizia, *Charan.*, est Galvesia, *Domb.* Agassizia, *Spach.*, est Sphærostigma, *Ser.*, et Holostigma, *Spach.*, subgenus merum Œnotheræ.*

2. *Helix annulata.*—From examinations of specimens of the Helix described on page 101, of this volume, lately received from Mr. Thomas R. Dutton, Dr. A. A. Gould has ascertained that it is only a young state of *H. striatella.* The note to page 101, was simply a remark based on the figures given by Mr. Case.—Eds.

3. *Ornithichnites.*—On page 79 of this volume, a statement made to us by Prof. Agassiz is inserted, respecting the number of joints in the different toes of birds, and the bearing of this fact upon fossil footprints.

The same relation was pointed out by Prof. Hitchcock in his Report on the Geology of Massachusetts, 1841, ii, 525, and adduced to prove that some of the tracks were actually those of birds. It is recognized by Dr. Deane, in vol. xlv, p. 180, (1843,) of this Journal, and also subsequently illustrated by him in the Boston Journal of Natural History, vol. v, 1845.

We are informed by Pres. E. Hitchcock, that the quadruped track figured by Dr. Deane on page 79 of this volume, (last number,) and supposed to be new, is the *Sauroidichnites palmatus* of his Geological Report, or the *Palamopus anomalus* of his new nomenclature as given in the Proceedings of the Association of American Geologists and Naturalists. He lately examined the original specimen in the collection of Mr. Marsh, and immediately recognized it as belonging to the species just mentioned.—Eds.

4. *Plesiosaurus megacephalus;* by S. Stutchbury, (Quart. Jour. Geol. Soc., No. 8, p. 411.)—This new species of Plesiosaurus was discovered in the gray lias of Somersetshire. Mr. Stutchbury, after a detailed description, mentions the following among the distinguishing peculiarities.

The neck is only one-third longer than the head; the head is as one to six of the whole length of the animal, and is equal in length to twenty of the cervical vertebræ; the tail is but one-third longer than the head. The cervical vertebræ are twenty-nine, out of ninety-four the whole number in the animal; they are slightly rugose and have a vertical height of seven inches and eight-tenths. The length of the humerus is thirteen and seven-tenths inches. The whole length is sixteen feet three inches.

5. *Physiological Remarks on the Statics of Fishes;* by Joh. Müller, (Ann. Mag. Nat. Hist., xviii, 69, July, 1486.)—Like all animals, fishes have a very delicate sense of the equilibrium of their body; they counteract any change in this respect by means of movements, partly voluntary, partly instinctive. These last are seen in a very remarkable manner in the eyes, and they are so constant, and so evident in the fish as long as it lives, that their absence suffices to characterize the death of the animal.

---

* The memoir of Prof. Gray, contains also descriptions of the new species *Vernonia Lindheimeri, Ageratum Wrightii, Brickellia cylindracea, Keerlia bellidifolia* and *Tetragonotheca Texana.*

The equilibrium of the body of a fish in the water is independent of the natatory bladder; this organ may even interfere with it; as the fish lies in its horizontal position with the back upwards, it depends solely on the action of the fins, and principally on the vertical fins.

The natatory bladder may assist the fish to increase or to diminish its specific gravity. By compressing the air which is contained in it, the fish descends in the water; and it rises again by relaxing the muscles which had served to compress the bladder. Moreover, the fish may remain at the bottom of the water, by the very fact of the pressure of the column of water on the air contained in the bladder.

By compressing more or less the posterior portion or the anterior portion of the bladder, the animal is able to render the anterior half or the posterior half of its body lighter at will; it can also take an oblique position, which allows a movement of rising or of descending in the water. The arrangement of the natatory bladder in some fishes appears to favor this action. The Cyprinoids and the Characi have two bladders, one before the other, communicating with one another by a narrow tube. The anterior bladder is very elastic, whereas the posterior one is but slightly so; and in proportion as the fish rises in the water, the anterior bladder, which is the most elastic, must considerably increase in volume, and thus keep the head of the animal up, whilst the contrary must be the case when the fish descends.—*Müller's Archiv*, 1845, p. 456.

IV. Astronomy.

1. *On the Attempts to explain the Projection of a Star on the Moon, during an Occultation;* by Prof. Powell, (Brit. Assoc., from the Athenæum, Sept. 26, 1846.)—Some remarks having been brought forward at the last meeting, relative to the singular phenomenon above named, in which "diffraction" was referred to as, at least, in a general sense, likely to afford an explanation, the author of this communication conceived that some observations which he had made might not be without a bearing on the question. "Diffraction" has often been appealed to in cases apparently of the same class; but, in the more strict and limited sense of the term, it cannot apply, since both the conditions and the resulting phenomena appear essentially different. The phenomena properly ascribed to "diffraction" exhibit *fringes*,—and suppose the edge of the intercepting body to be *within* the area of the rays. But there are some effects of a concomitant kind, which have been less attended to. One of the most remarkable of these is that described by Newton, (Opt., book iii, part i, obs. 5, 6, 7,) in which the light admitted through a hole one quarter of an inch in diameter, falling on the edge of an opaque body, besides the phenomena since called "diffraction," gave rise to long streaks or "trains" of light darting into the shadow perpendicular to the edge, shown on a *screen;* or, when the *eye* was substituted, producing a *luminous line* running along the edge, between it and the first fringe. It does not seem that any subsequent experimenter has reproduced this part of the phenomenon, and it probably requires the most extreme precaution. The author has succeeded in another way, as follows: The aperture being one quarter of an inch diameter, at a distance of about eight feet was placed a circular opaque disk, three quarters of an inch diameter; and at two feet beyond

it an eye lens of two inches focal length. The dark disk appeared with a trace of faint diffractive fringes round it; and a number of *streaks or trains of light* converging from its edge to its centre, which there crossing gave rise to a *bright round spot.* The appearance of *separate* streaks is clearly due to the irregularities of the edge; since with a *polished* edge they were not perceptible, and only a faint light was seen, but giving rise to a well defined bright circular spot at the centre. Corresponding streaks appeared when a straight edge was used perpendicular to it. Though, in this experiment, the edge is *within* the area of the rays, yet a part of the same phenomenon (viz., the line of light along the edge) is seen, even when the edge is *beyond* the rays, by the naked eye, or with a telescope. When the orifice of light is reduced to a mere point (as by using the sun's rays reflected from a very small globule of mercury,) and the rays are *wholly* intercepted by the disk at the distance of about two inches, so that both the luminous point and the disk may be seen at once in focus by a small telescope about twelve feet distant, the luminous patch on the edge of the disk at the part nearest the luminous point appeared to extend to a small distance *inwards*, and there the rays converging crossed, and diverged again faintly. This might possibly be regarded as affording some experimental imitation of the case of the star. The orifice is not an absolute point; but, if it were, the patch of light on the disk might appear like a projection of its image. Another explanation has been proposed of the phenomenon of projection; on the principle that, owing to *aberration*, the star being seen out of its true place, a screen, placed in its *true* direction, as the moon, would exhibit the star projected on its disk (Astron. Soc. Reports, vi, 246); and, taking into account the *proper motions* of the star, this will explain the appearance of the phenomenon in one instance and not in another, on the supposition that those proper motions are in opposite directions in the two instances. But this will not apply in the very instance to which reference has been made,—of the two stars 119 and 120 Tauri,—which have proper motions both in the same direction. Also the *principle* of this explanation is rendered questionable altogether, from what has been lately suggested by Prof. Challis, on the theory of aberration. The whole subject is, perhaps, not yet ripe for explanation, since the first astronomers are so much at variance as to the facts,—the appearance having been often seen by one observer, and not by another: while it is believed by some to occur or not, according as the attention is directed to the moon or to the star; which, if true, would seem to point to some ocular cause. Hence, a further accumulation of instances is much wanted: any statement of which Prof. Powell would be thankful to receive, addressed to him, at Oxford.

2. *Astronomical Observations made under the direction of* M. F. Maury, *Lieut. U. S. Navy, during the year* 1845, *at the U. S. Naval Observatory, Washington;* Vol. i, published by authority of the Secretary of the Navy.—In the number of this Journal for March, 1846, p. 294, we gave a brief description of the Naval Observatory at Washington, with a notice of each of the principal instruments. We concluded that notice with the remark, "The public are anxiously looking for the fruits of this noble establishment. May their reasonable expectations not be followed by disappointment." We confess we had at the time some misgivings as to the fate of this enterprise. The project of a National Observatory had hitherto received so little favor at Wash-

ington, that it seemed too much to expect that opposition would now entirely and forever cease. But thus far, opposition (if any has been entertained) seems to have remained quiet; and we are now presented with the first fruits of the Observatory, in a quarto volume of 550 pages. We could wish that the observations were printed from larger type, on thicker paper, and that the volume was furnished with a more substantial covering; but we feel under too great obligations to the late Secretary of the Navy, to complain.

The Observatory is furnished with five capital instruments, viz. an Equatorial of fifteen feet focus; a seven feet Meridian Transit; a five feet Mural Circle; a seven feet Transit in the Prime Vertical; and a thirty inch Meridian Circle. No report is made of observations with the equatorial for 1845, and those made with the meridian circle, proving unsatisfactory, are not yet published. The three remaining instruments furnished the observations of the present volume. The work with the meridian transit instrument commenced April 22, and by the close of the year, 3200 observations were obtained, being an average of about twelve per day. At the Greenwich Observatory, the number of transit observations averages about eight per day. The work with the mural circle commenced Jan. 21, and by the close of the year, 2100 observations were obtained, averaging about six per day. At Greenwich the average is about eight per day. As to *amount of work*, therefore, our own Observatory compares well with Greenwich. But a much more important question respects the *accuracy* of the observations. We may form some opinion on this point, by noting the accordance of the observations with each other. We have therefore selected the twelve stars which were most frequently observed with the transit instrument, and have compared the mean Right Ascensions deduced from them. These may be regarded as observed values of the *same* quantity; and the differences among them indicate errors of observation, or unknown causes of anomaly. The following Table shows the difference between the *greatest* and *least* observation of each star, reduced to its equivalent upon the equator; and for comparison we have made a corresponding selection from the Greenwich observations for 1837.

Washington.			Greenwich.		
Object.	No. obs	Extreme diff'e.	Object.	No. obs	Extreme diff'e.
α Andromedæ,	38	$0^s{\cdot}24$	Polaris,	103	$0^s{\cdot}24$
γ Pegasi,	40	24	Spica,	32	47
α Cassiopeiæ,	36	54	η Bootis,	31	28
θ^1 Ceti,	39	76	Arcturus,	47	35
α Lyræ,	32	70	ε Bootis,	39	22
δ Aquilæ,	36	49	α Cor. Borealis,	30	22
γ Aquilæ,	33	85	α Lyræ,	27	27
α Aquilæ,	33	54	γ Aquilæ,	37	28
ε Pegasi,	33	56	α Aquilæ,	47	38
ζ Pegasi,	38	67	β Aquilæ,	28	34
α Piscis Australis,	44	54	ζ Pegasi,	33	27
α Pegasi,	31	33	α Pegasi,	34	27

The average difference between the extreme observations at Washington is $0^s{\cdot}54$; at Greenwich, $0^s{\cdot}30$. We consider it highly credita-

ble to the Washington observers, that in the first year of their experience, the results of their observations should accord nearly as well as those of the long practised observers of Greenwich.

We have instituted a similar comparison with regard to the observations with the Mural Circle. The following Table shows the difference between the greatest and least mean Declinations deduced from the twelve stars most frequently observed, excluding the reflected observations; and for comparison we have taken all the direct observations of the twelve stars most frequently observed at Greenwich in 1837, with the Troughton mural circle.

Washington.			Greenwich		
Object.	No. obs.	Extreme diff'e.	Object.	No. obs.	Extreme diff'e.
Polaris,	135	4″·38	Polaris,	45	4″·11
α Persei,	16	3· 76	Sirius,	58	7· 79
α Ursæ Majoris,	20	6· 76	α Ursæ Majoris,	14	2· 32
β Ursæ Minoris,	16	4· 79	γ Ursæ Majoris,	21	4· 20
γ Draconis,	25	3· 37	ζ Ursæ Majoris,	20	4· 36
δ Ursæ Minoris,	17	5· 02	η Ursæ Majoris.	33	4· 40
α Lyræ,	48	6· 88	Arcturus,	15	3· 84
η Lyræ,	21	2· 58	β Ursæ Minoris,	18	3· 30
γ Aquilæ,	18	3· 11	η Draconis,	21	3· 75
61 Cygni,	19	4· 22	β Draconis,	14	4· 67
α Piscis Australis,	29	5· 50	α Lyræ,	13	3· 75
γ Cephei,	44	3· 99	φ Sagittarii,	14	3· 73

The mean of the differences at Washington is 4″·53; at Greenwich 4″·18; and the number of observations at Washington is the largest: from which we see that the Washington mural observations accord quite as well as those of Greenwich. We conclude, then, that the Astronomers at Washington are *good*, as well as *active* observers, and deserve the confidence of the public. We trust therefore that Congress will allow them a fair field for their activity; and we believe they will produce results highly creditable to our country, and important contributions to the science of Europe. We trust, moreover, they may be indulged in their favorite scheme, that of preparing an American Nautical Almanac. Is it not a disgrace that our national ships, to say nothing of our thousands of merchant vessels, should be indebted to a foreign country for a periodical without which not one of them would dare venture to sea? It is not true, as is sometimes thought, that the English almanac fully meets the American demand. A large amount of local science would find its appropriate place in an American Almanac, which could not be expected in a foreign one.

After the favorable opinion we have thus freely expressed respecting the Washington observations, perhaps we may be indulged in a few suggestions. We have remarked some deficiences which are excusable under the circumstances of the first volume, but which we hope may be remedied in future ones. We wish to see the observations of the sun, moon, and planets, fully reduced, and compared with the Nautical Almanac. The circumpolar stars α, δ, and λ, Ursæ Minoris, and 51 Cephei, are omitted in the catalogue, p. 272, and in the reductions, p. 246, although they were repeatedly observed. We do not understand

the cause of this omission. We think there are too many interrogation points (?) in the table of mean declinations, p. 262, while most of the observations to which they are attached accord very well with the general mean.

It may seem almost puerile to descend to verbal criticism, but we confess we should be better pleased if there was a less parade of "nautical phrases." When we meet on almost every page such expressions as "fitting up an observatory from a girt-line—exactly amidships of the slab—like a close hatch on ship board—reckoning from the midship point—set to work right off the reel—level amidships of bearing bands—the bands to the mainmasts of a ship—midship points of the level guides—the instrument was landed on the V's—from the midships of one V to the midships of the other—the eye-piece was shipped—as taut as a bar"—we poor landsmen are obliged either blindly to guess at the meaning or betake ourselves to a vocabulary. It may be thought hard if a naval officer in a naval observatory cannot be allowed to speak his native dialect; but we would enquire whether this volume of Observations is addressed primarily to sailors. In conclusion we must again express the high satisfaction we have derived from an examination of this volume, and trust we may soon be favored with a copy of the observations for 1846.

3. *Memoria sopra i colori delle Stelle del Catalogo di Baily, osservati dal P. Benedetto Sestini della compagnia di Gesu.* Roma, 1845. 20 pp. 4to.

Stelle del Catalogo di Baily dal polo boreali fino a 30° *di Decl. Australe contrassegnate secondo i loro diversi colori osservati nella specola del Collegio Romano.* Fascicolo I. 12 maps folio.

We are here presented with a short Memoir on the colors of the stars of Baily's Catalogue, observed by P. B. Sestini at the Observatory of the Roman College, accompanied with maps, on which the observations are graphically represented. It is well known that different observers have given us materially different estimates of the color of many stars. It is important to know whether these differences arise from real changes of color; from atmospheric or instrumental causes; or from errors of observation. It is believed that some stars have undergone real changes of color within the period of history. Thus Sirius is now one of the whitest stars to be seen. But Horace denominates it 'rubra,' and Seneca calls it a deeper red than Mars itself; while Ptolemy confirms the same statement. β Geminorum is classed in the Almagest among the few stars of a red color, while at present it is decidedly white.

M. Sestini has therefore undertaken to make a careful estimate of the color of all of Baily's stars, expecting that we may hereafter be able to detect changes in some of them. From the well known purity of the Italian sky, and the excellence of the telescope employed, we have great confidence in Sestini's estimates. The colors are represented upon the charts in the following manner:—A horizontal line is drawn through the star, with seven vertical dashes, thus $\frac{1}{|}\ \frac{2}{|}\ \frac{3}{|}\ \frac{4}{*}\ \frac{5}{|}\ \frac{6}{|}\ \frac{7}{|}$, three on each side of the star, and numbered from left to right. Number 1 denotes red, number 2 orange, 3 yellow, 4 green, 5 blue, 6 indigo, 7 violet. The white stars have no mark affixed to them. The Catalogue

and Maps now published embrace all of Baily's stars for half the northern hemisphere, from the 12th to the 24th hour of R. A. We trust M. Sestini will be encouraged to complete the work he has begun, and will give us the colors of the remaining stars of Baily's Catalogue, and perhaps extend his plan so as to embrace a still wider range.

4. *Sixth Comet of* 1846, (Colla, in L'Institut, Nov. 11, 1846.)—A telescopic comet was discovered June 26, 1846, in *Scorpio*, near the star 595 Mayer, by the German astronomer, M. Peters, at the Royal Observatory at Naples. It was followed by him till July 23, during which period he secured observations on nine different evenings. It appears to have been observed nowhere else, except once at Rome. At the time of its discovery it was very faint, without sensible nucleus, and resembled nebula No. 19 of the 6th class of Herschel, from which it was about a degree distant. Its motion was northward and increasing in R. A., and its appearance always very dim. M. Peters computed the following parabolic elements.

Perihelion pass. 1846, May 30, $12^h\ 56^m\ 3^s$ m. t. Berl.

Long. of perihelion,	237° 20′ 23″·2	M. equin. Jan. 0.
" " asc. node,	258 44 47 ·6	
Inclination, . .	34 0 41 ·7	
Perihelion dist. .	1·6019	
Motion, ...	direct.	

M. D'Arrest of Berlin, also calculated two sets of parabolic elements. As neither of them well satisfied the observations, he computed the following elliptic elements, which agree better with the observations.

Epoch, 1846, July 21, 8^h Berlin.

M.	3° 6′ 47″·1	
L.	242 56 38 ·5	M. equin. 1846.
π	239 49 51 ·4	
Ω	260 12 25 ·1	
i	31 2 14 ·4	
φ	49 10 34 ·3	
log. a	0·800762	
Sid. Revolution, . .	5804·3 days.	

5. *Hind's Comet*, (Colla, in L'Institut, Nov. 11, 1846.)—The telescopic comet discovered by Mr. J. R. Hind at London, July 29, 1846, (see ii Ser., vol. ii, p. 439,) had been detected two hours previous, by De Vico at the Observatory of Rome. It was observed during about a month. Various sets of the parabolic elements of its orbit have been published, differing widely from each other, and from the provisional elements furnished by Mr. Hind.

The elements by Funk, Powalsky, and Oudemans, agree tolerably well. The following is the set computed by Oudemans.

Perih. pass. July 28·502 m. t. Berlin.

Long. of perihelion, ...	2° 33′
" " asc. node, ...	147 10
Inclination, ...	64 42
Log. Perih. dist.	1·04621
Motion, ...	retrograde.

6. *Le Verrier.*—Honors have been falling thick about Le Verrier since his splendid discovery. He has been made an officer of the Le-

gion of Honor by the King of France; and besides, a chair has been established for him at the Faculty of Science at Paris, entitled Mathematical Astronomy or Celestial Mechanism. A bust of him has also been ordered by royal authority for the College of Saint-Lô, and M. Pradier is appointed to execute it. From the King of Denmark, he has received the title of Commander of the Royal Order of the Danebrog, and the Royal Society of London has conferred on him the Copley medal.

7. M. GALLÉ.—The cross of the Red Eagle has been conferred, by the King of Prussia, on the discoverer of Le Verrier's planet.

V. MISCELLANEOUS INTELLIGENCE.

1. *Effects of the Earth's Rotation upon Falling Bodies and upon the Atmosphere;* by W. C. REDFIELD, (communicated for this Journal.) —From the remarks which were made *On the Deviation of Falling Bodies from the Perpendicular*, before the British Association at Southampton, by Professor Oersted and others, as noticed in the miscellanies of this Journal for January, p. 139, it appears that while the deviation towards the east is explained by the fact that the velocity of the earth's rotation is proportioned to the distance from the axis, the alleged deviation towards the *south*, in northern latitudes, is unaccounted for.

I apprehend that this latter deviation is due to the same cause as the former. While gravitation is found to be perpendicular to the surface, the direction of the rotary (or centrifugal force) is always in a plane, which is parallel to the plane of the equator, whatever the latitude. Hence this force acts obliquely to the perpendicular course of a falling body, from the beginning of its descent, and tends in northern latitudes, to lift the body southward, during its fall. Or to explain:—the latitude of any body situated above the surface of the earth is the same with that point on the surface, which is intersected by a line from the earth's center to the body. If then, the body have its distance from the surface increased in a plane parallel with the equatorial plane, it must diminish its latitude; for a line drawn between it and the earth's center, will intersect the surface nearer and nearer the equator, as the body recedes. Now the tendency of centrifugal force is to carry a body away from the surface tangentially, in the manner above stated, and consequently, besides producing an easterly motion in the falling body, it must also produce a southerly motion.

Again: if to a falling body, in the northern latitudes, there be superadded a force which is *centripetal in the plane of rotation*, this force, being perpendicular not to the surface but to the axis, must necessarily produce a deviation to the *northward*. I see not how this can be questioned: and, if true, it must equally follow that the *centrifugal* force which pertained to the body at the beginning of its descent, tending as it does *from* the axis, must produce a southwardly deviation.

Thus the resultant effect of the rotary force at the point where the body begins to fall, is such as will produce a *southeastwardly* deviation from the perpendicular during its descent, in northern latitudes.—It is hardly necessary to add, that a northeastwardly deviation from the perpendicular belongs to falling bodies in the southern hemisphere.

The increase of the rotary velocity and centrifugal force in proportion to the distance from the axis, I have been accustomed to consider as one of the causes which may serve to account for the non-appearance, and, as I think, the non-existence of those great ascending currents which have been ascribed to the equatorial regions of the atmosphere as well as of their alledged overflow towards the poles in the upper regions: for the increased centrifugal force, above that in the lower regions, not only opposes a flow towards the poles, but, in each successive plane of rotation in proceeding from the equator, becomes proportionally greater than the perpendicular elevation from the surface, in a ratio which increases with the increase of latitude.

Thus the immediate influence of the earth's rotation may be such as favors the production of currents in the higher regions of the atmosphere, moving from points between west and north in northern latitudes, and from between west and south in the southern hemisphere.

The law of increased density from the diminution of temperature, seems, likewise, to favor a greater oblateness of figure in the exterior portions of the earth's atmosphere than would otherwise be due to its relative conditions at different altitudes: as may be inferred from the contrary effect that is shown in the diminished oblateness of the earth which results from the increased density towards its center, as has been proved by Clairaut.*

According to these views, the greater expansion of the lower atmosphere which results from the increased temperature of the intertropical latitudes, may have little influence in determining the actual courses of circulation. It is not intended, however, to place undue reliance on these views, in estimating the dynamics of the atmosphere. It seems evident that there are other conditions which serve to counteract or prevent any general winds, as based solely or mainly on an alleged ascent of aërial currents in the equatorial region, from the lesser specific gravity of the lower atmosphere in the warm latitudes.

In a highly respectable work, the origin of the polar currents of the ocean has been referred, in a great measure, to the centrifugal force which is the result of the earth's rotation.† Now, if this view be so enlarged as to include *all* the physical influences and conditions (other than geographical variations of temperature) that must necessarily pertain to the diurnal rotation and orbital progression of the planet, I cannot see that the calorific theory of Halley is necessary for explaining the principal movements which are observed in our atmosphere.

New York, Jan 7, 1847.

2. *Smithsonian Institution.*—The Regents of the Smithsonian Institution held a session in Washington in the month of January, for the purpose of discussing plans for its organization, which should best promote the designs of the testator, "*for the increase and diffusion of knowledge among men.*" This clause in the will of Smithson, clearly indicates two entirely distinct objects, requiring two separate, but harmonious and confluent plans of conduct, for the full development of the greatest good of which the Institution is capable.

---

* Théorie de la Figure de la Terre; Paris, 1808.

† Library of Useful Knowledge, Art. *Physical Geography*, p. 28.

We understand that the Regents have decided to divide the available income of the fund, equally between the two recognized modes for increasing and diffusing knowledge, viz., by stimulating research, and by collections. The salary of the Secretary as head of the Institution, is to be equally assessed on the two divisions.

Under the first head it is designed to publish Transactions, to be called Smithsonian Contributions to Knowledge, in which shall appear those papers only, which are a positive addition to the great sum of human knowledge in whatever department. Original and important researches, whether undertaken on the suggestion and at the expense of the Institution, or the result of individual authorship,—elaborate memoirs, the costliness of whose publication would be a bar to their appearance at the charge of the author, or of scientific societies already organized, will find their place in these Transactions. Lines of research, suggested either by competent persons in the several departments of knowledge, or pointed out by the officers of the Institution, will be confided to able hands who may be encouraged by suitable grants of money to produce results in the branches committed to their care for publication. Premiums for investigations will be awarded, and the results published. In this way it is confidently believed, that the Institution will become a most important auxiliary to the science, literature, and arts of the country, and will accomplish in the most effectual manner the first object of its liberal founder.

Public lectures on various literary and scientific topics, by able men employed from time to time for the purpose, will be an important and popular means for the diffusion of knowledge; and the subsequent publication of such lectures at the discretion of the Regents, will extend the privileges of the Institution to those not resident at Washington. It is also proposed, we understand, to publish at stated intervals, condensed and well digested reports on the progress of the various departments of knowledge, somewhat after the manner of the annual reports of the Swedish Academy, but not confined to subjects of merely scientific interest. The best aid at the command of the Institution will be procured to elaborate these reports, as well as in the preparation of tracts or essays designed for wide distribution, on the plan of the publications of the London Society for the diffusion of useful knowledge. These will be sold at the minimum cost of production, so as to be accessible to all, while the usefulness of the Institution will be greatly extended by the extensive sale of its publications, which will thus return the cost of their production, to be again employed in similar channels. It is proposed to make arrangements with the Academy of Design, the Artists Fund Society, and similar institutions, for the exhibition of works of American art.

The second great department embraces objects of various interest and much importance. The custody and increase of all collections, in arts, science and literature, including books, cabinets of natural history, instruments, objects of art, antiquity and curious research, will all properly fall under this head.

An economical disbursement of the income, will thus enable the Regents to accomplish much more with a limited sum than might at first appear possible. Mr. Jewett, late Librarian of Brown University, Providence, R. I., has been appointed the Librarian of the Institution.

The Secretary of the Institution, (Prof. Joseph Henry,) has been directed to continue his researches and to report his results; to prepare a number of the Contributions for publication, and after communication with eminent scientific and literary men, to fix upon methods for executing the other plans "for the increase and diffusion of knowledge among men."

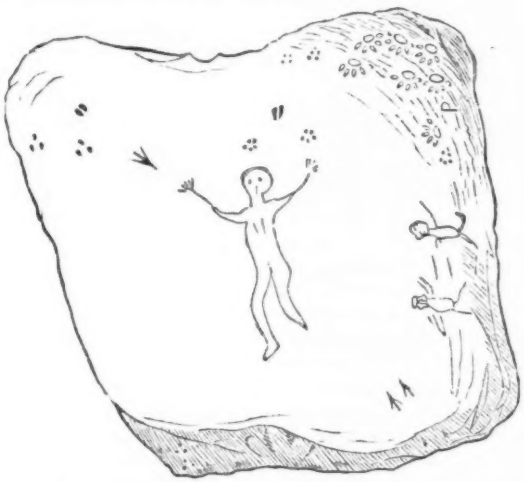
The organization also embraces the plan of setting apart certain evenings, for the purpose of enabling artists and inventors to exhibit and explain their instruments or works of art in the halls of the Institution, as in the Polytechnic Institution in London, to such as may attend the soirées.

The plans of Mr. James Renwick, Jr., of New York, for the building, were adopted with modifications, and it was agreed that the building should be erected gradually, out of the accruing income of the fund and funded interest. The plans are in the Roman style, and consist of a centre building and wings, the latter of which it is proposed to erect first as containing accommodations for a laboratory, lecture-room, temporary library, and gallery of art. Thus during the progress of construction, a part of the accommodations required can be furnished, and it is believed that with due economy, a suitable fire-proof building may be erected in the course of six or seven years, while the Institution is simultaneously yielding fruit of permanent value. A salutary dread of the fate of certain other public institutions, should deter the Regents from a lavish expenditure of their sacred funds in ornamental architecture. The Regents of this Institution are in fact the trustees and executors of the will of Mr. Smithson, and are bound by every obligation faithfully to discharge their trust, "the increase and diffusion of knowledge among men"—and not to paralyze their future usefulness by locking up their available means in an attempt at display, which at most can poorly compete with the stately structures of the national government. The General Post Office at Washington cost over half a million of dollars, the Patent Office $750,000, and the Treasury Department still more. Making every allowance for bad economy in the erection of these buildings, is it not quite impossible for the Smithsonian Institution, with its comparatively limited funds, to go a step beyond the bounds of absolute necessity? It is to be hoped, that under the design of erecting a monument to the memory of Smithson, they may not place a cenotaph over the buried usefulness of their sacred trust. This monument is to be built in the hearts of the people, and at every fireside in the land, and not in this land only, but everywhere; for the trust is given not for the benefit of the whole American people only, but for "mankind." The wise councils of those who have so far succeeded in harmonizing conflicting views, as to accomplish what we have already sketched, will have the hearty approval and coöperation of all those who desire the permanent prosperity of the Institution.

3. *Footprints and Indian Sculpture*, (communicated by Rev. E. H. Davis, of Chillicothe.)—During a late excursion along the Ohio valley for the purpose of examining some mural remains, our attention was directed by several persons to two sculptured rocks upon Guiandotte river, as something very remarkable. Taking nothing for granted received by hearsay, we determined to visit them; so we proceeded up the river about eighteen miles from its mouth, where we found the two rocks in question just below the falls.

While Mr. Squier was sketching these, I commenced a search among the other rocks in the neighborhood in quest of more hieroglyphics; some hundreds of these blocks of all sizes were strewed along the plain, having tumbled down from an unstratified layer of coarse sandstone, which occurs forty feet thick in the hill above. My efforts were crowned by the discovery of three others, mostly covered by a slip from the hill; sketches of these have also been taken. They resemble in every respect many other sculptured rocks found all over the Western States, wherever sandstone or even limestone exists suitable to be wrought by rude instruments. Some of the characters are like those upon the Dighton, Tiverton, and Portsmouth rocks, about which so much interest has been felt in the North of Europe. They are generally outline figures of full size, cut into the rock from one half to one inch in depth and the same in breadth. They consist of the human form, quadrupeds, birds, reptiles, dots and lines, with the tracks or footprints of animals and birds.

It is to these footprints that I wish to direct your attention in particular, as possessing some interest for the geologist, as well as the antiquarian. In many instances they are so well executed, and life-like, as to deceive the most experienced geologist; for example, the human footprints in the limestone near St. Louis, first figured and described by Mr. Schoolcraft,* which remained for many years a geological wonder, but were at last satisfactorily explained by Dr. Owen.† The Derry sandstone in Westmoreland County, Penn., with the supposed fossil footprints of birds and quadrupeds, described by Dr. King,‡ are of the same class of artificial tracks, and were correctly so considered by Mr. Lyell who examined them personally.§



The figure here given is a sketch of one of the Guiandotte rocks, covered as you will perceive with a variety of these sculptured tracks,

* Am. Jour. of Sci., vol. v, p. 223.
† The same, vol. xliii, p. 14.
‡ The same, vol. xlix, p. 216.
§ Second Series, vol. ii, p. 25.

as additional confirmation (if any should be needed) of the views of Dr. Owen and Mr. Lyell; to which I will add but one or two observations in conclusion.

1st. In nearly every instance where these footprints are found, they are in connection with well known Indian sculptured figures.

2d. They occur at all angles with the plane of strata, on the sides and ends of blocks as well as the top.

3d. Iron seams, as hard as steel, frequently occur in this sandstone; and wherever a footprint is found over one of them it is excavated on either side, leaving the seam as too hard for the instrument. As yet I have never met with any footprints in the Western States, that have not proved, upon a critical examination, to be sculptured by Indians.

4. *Hecla.*—From letters by M. Descloiseaux, (Comptes Rendus, Oct. 26, and Nov. 16, 1846.)—Mount Hecla is a very regular cone, with slopes of twenty-five to thirty degrees, covered with scoria and fragments. The height was determined by two observations at 1386·3, and 1396·8 metres, which is more than 160 metres less than former trigonometrical measurements. The great current of 1845 flowed to the west-south-west; the whole length is sixteen kilometers, (near ten miles,*) and the greatest breadth two kilometers. It is found covering declivities of all angles, from 0° to 25°, and every where the surface consists of blocks, often of large size, accumulated with some regularity, and forming a broad band having the lateral slopes thirty-five to forty degrees. Over the surface there are numerous fumeroles, about which no salts were observed excepting sal-ammoniac.

M. Descloiseaux has collected confervæ from the geysers, where the waters were at a temperature of 98° C. (= 208° F.)

Experimenting on the great geyser, which is twenty-two metres in depth, this geologist found the temperature at one trial 121°·6 C., within six metres of the bottom; 121° C., within 9·5 metres; 109°·3? within 16·3 metres; and 95° ? within 19·7 metres. At another trial, the temperature within a foot of the bottom was 123·6 C.; at 4·8 metres above the bottom, 122°·7 C.; at 9·6 metres 113° C.; 14·4 metres, 83°·8 C.; 19·2 metres, 83·6 C. In a *third* trial, at the bottom, 127°·5 C.; 14·75 metres above the bottom, 106·4 C.; and 19·55 metres above, 85°·2 C. In a *fourth*, 126·5° C., at the bottom; 110° C., 14·75 metres above the bottom; 84·7 C., 19·55 metres above. In a *fifth*, 122°·5 C., at bottom; and 103° C., at 13·5 metres above the bottom.

5. *Cultivation of Cereal Grains in Cold Climates*; by A. T. Kupffer, (Acad. Sci. St. Petersburgh; L'Institut, No. 668, Oct. 1846.)—After speaking of the temperature of the earth in northern Russia, M. Kupffer states that near the mines of Nertchinsk, where the mean temperature is about 26° F., all the cereal grains are cultivated with success, especially summer rye and barley, although there are only two months and a half, or at the most three months between ploughing and harvest. In the same fields, he found, by digging, that the soil was completely frozen at a depth of seven feet, and so hard that a crowbar was required to turn it up. This was on a hot day near the middle of the month of August. M. Kupffer remarks, that as there is an increase of temperature in the earth downward, and also an external source of heat in the

* A kilometre is 3281 feet, or nearly *five-eighths* of an English mile.

sun, the depth at which ice occurs and the thickness of the bed of frozen earth, will vary with the season of the year. The summer heat is prevented from melting to much depth by the slow conduction of the earth and the amount of latent heat taken up by the process. In the mines of Trekhsvetitelski, situated 470 feet (Paris) above the magnetic Observatory of Nertchinsk, 2,470 feet above the sea, and where the mean temperature just above the soil should therefore differ about 1·5° F. from that of Nertchinsk, it was found that to 175 feet (the depth penetrated) there was not a drop of water; all was frozen. In the mines of Vosdvigensk, not far from Nertchinsk, and about 2,708 feet above the sea, flowing water occurs at a depth of 300 feet, having a temperature of 35°·8 F. To a depth of forty or fifty feet, the sides of the shafts were perfectly dry, and at this depth the mean temperature of 32° F., appears to be situated. This last point was not fully verified; but if true, it gives an increase of 3·8 F. in a depth of 250 feet, which accords very nearly with observations elsewhere.

In connection with this subject, the following table is given showing the increase of mean temperature, as we pass from the coast towards the interior of Russia, between the parallels of 50° and 60°.

	Latitude.	Longitude E. from Paris.	Height in English feet.	Mean temp.	Dif. mean temp. of summer & wint'r.
	° ′	° ′			
St. Petersburg, .	59·57	27·59	0	37·8F.	65·8F.
Moscow, . . .	55·45	35·17	400	38·5	71·6
Kasan, ...	55·48	48·48	150	35·0	75·9
Catherinenberg, .	56·50	58·14	820	33·1	76·8
Bogoslowsk, . .	59·45	57·39	600	30·9	79·2
Tomsk, ...	56·30	82·50	300	31·5	81·5
Barnaoul, . . .	53·20	81·07	400	31·5	82·9
Irkoutsk, . . .	52·17	101·15	1300	31·5	79·9
Nertchinsk, . .	51·18	117·01	2000	26·2	94·3
Iakoutsk, . . .	62·01	127·24		17·2	110·7

6. *On Comparative Analytical Researches on Sea Water;* by Prof. FORCHHAMMER, (Proc. Brit. Assoc., from the Athen., Sep. 26.)—In the ocean between Europe and America the greatest quantity of saline matter is found in the tropical region, far from any land; in such places 1,000 parts of sea water contain 36·6 parts of salt. This quantity diminishes in approaching the coast, on account of the masses of fresh water which the rivers throw into the sea: it diminishes, likewise, in the westernmost part of the Gulf stream, where I only found it to be 35·9 in 1,000 parts of water. By the evaporation of the water of this warm current, its quantity of saline matter increases towards the east, and reaches, in N. lat. 39° 39′ and W. long. 55° 16′, its former height of 36·5. From thence it decreases slowly towards the northeast: and sea water, at a distance of from sixty to eighty miles from the western shores of England, contains only 35·7 parts of solid substances; and the same quantity of salt is found all over the northeastern part of the Atlantic, as far to the north as Iceland, always at such a distance from the land that the influence of fresh water is avoided. From numerous observations made on the shores of Iceland and the Faroe Islands, it is evident that the waters of the Gulf stream spread over this part of the Atlantic Ocean; and thus we see that the water of tropical currents

will keep its character even in high northern latitudes. In the longitude of Greenland, and more than one hundred miles to the south of the southernmost point of that large tract of land, sea water contains only 35·0 in 1,000 parts. In going from this point towards the northwest, it decreases constantly; and in Dover Straits, at a distance of about forty miles from the land, it only contains 32·5 parts of salt in 1,000 parts of sea water. This character seems to remain in the current which runs parallel to the shores of North America; and at N. lat. 43½°, and W. long. 46⅓°, the sea water contained only 33·8 parts of salt. Thus tropical and polar currents seem not only to be different in respect to their temperature, but also in the quantity of salt which they contain; and thence it follows, again, that while the quantity of water carried away from the *tropical sea* by evaporation is greater than that which rain and the rivers give back to the sea, the reverse takes place in the *polar seas*, where evaporation is very small and the condensation of vapor very great. The circulation must on that account be such, that a part of the vapor which rises in tropical zones will be condensed in polar regions, and, in the form of polar currents, flow back again to warmer climates. Although my analyses are only made on water from the ocean between Europe and America, yet little doubt can be entertained that also that part of the ocean which separates America from Asia is in a similar condition; and that currents flowing from the poles are the rule, and currents flowing towards the poles the exception. Besides the southerly direction, which any current flowing from the northern polar regions must take, it will, according to well known physical laws depending upon the rotation of the earth, always take a direction towards the west, and thus be driven towards the eastern shores of the continents; while any tropical current flowing towards the north will, according to the same laws of rotation, take a direction towards the western shores of the continents. This is at present the case in the Atlantic Ocean; and its effects upon the shores of Europe, which are surrounded by warm water from a branch of the tropical current, produce a mild and moist climate. The water of the different seas is much more uniform in its composition than is generally believed. In that respect my analyses agree with the newer analyses of atmospheric air in showing that the differences are very slight indeed. Sea water may contain more or less salt,—from a very small quantity, as in the interior part of the Baltic, to an amount of 37·1 parts in 1,000 parts, which I found in water from Malta, and which is the greatest quantity I ever observed; but the relative proportion of its constituent saline parts changes very little. In order to get rid of those differences which might arise from the different quantity of saline matter in sea water, I have compared sulphuric acid and lime with chlorine, and the following results are the mean of many analyses:—In the Atlantic, the proportion between *chlorine* and *sulphuric acid* is 10,000 to 1,188; this is the mean of twenty analyses, which differ very little from each other. In the sea between the Faroe Islands, Iceland, and Greenland, the same proportion, according to the mean of seventeen analyses, is 10,000 to 1,193. In the German Ocean, according to ten analyses, it is 10,000 to 1,191. In Davis's Straits, according to the mean of five analyses, it is 10,000 to 1,220. In the Kattegat, according to the mean

of four analyses, 10,000 to 1,240.—Thus it appears that the proportion of sulphuric acid increases near the shores: a fact which evidently depends upon the rivers carrying sulphate of lime into the sea. The proportion between *chlorine* and *lime* in the Atlantic Ocean, according to the mean result of seventeen analyses, is 10,000 to 297; and in the sea between Faroe and Greenland, according to the mean of eighteen analyses, 10,000 to 300. Lime is rather rare in the sea around the West Indian Islands, where millions of coral animals constantly absorb it, the proportion, according to five analyses, being 10,000 to 247; and it is rather copious in the Kattegat, where the numerous rivers of the Baltic carry a great quantity of it into the ocean. The proportion there is 10,000 to 371, according to four analyses.

7. *On the Iron Manufacture of Great Britain;* by Mr. G. R. Porter, (Proc. Brit. Assoc., from Athen., Sept. 26.)—Having called attention to the enormous demand for iron consequent on the general and simultaneous construction of railways in England, on the Continent, and in India, Mr. Porter said it was important to consider how that demand may be met, and also how, on the cessation of that demand, which must be temporary to a great extent, the ruinous depreciation of capital and suspension of employment, consequent on the change, may be averted. In 1788, the whole quantity of pig iron made in England and Wales, amounted to no more than 61,300 tons; of which 48,200 were made with coke of pit-coal, and 13,100 from charcoal: in the same year the amount raised in Scotland was 7,000 tons. In 1796, the quantity, owing to Watt's improvement of the steam engine, was nearly double, being—

England and Wales, ...	108,993 tons.
Scotland, ...	16,086 "
Total	125,079 "

Ten years later, viz. in 1806, when it was proposed to tax the production of iron, an inquiry was made, and the production was found to have more than doubled in this decennial period, being—

England and Wales	234,966 tons.
Scotland	23,240 "
Total	258,206 "

In 1823, this quantity had risen to 482,066 tons, and in 1830 it was further increased to 678,417 tons. But since 1830, in consequence of the introduction of the hot blast by Mr. Nelson, of Glasgow, rapid improvements have been made, and a most important saving of fuel effected. The results were thus stated:—In 1829, using coke and cold air, each ton of iron required for its production 8 tons, 1 cwt. 1 quarter of coal. In 1830, using coke and heated air, each ton of iron was made with 5 tons, 3 cwt. 1 quarter of coal. In 1833, using raw coal and heated air, each ton of iron consumed in its production, 2 tons, 5 cwt. 1 quarter of coal. The saving in fuel is thus seen to amount to 72 per cent.; and in Scotland the production of iron has risen from 37,500 tons in 1830 to nearly 500,000 tons in the last twelve months. There exists a prejudice against the hot blast iron which is gradually abating; and a similar prejudice long preventing the use of the black

band ore, the value of which was discovered by Mr. Mushett so far back as 1801. In 1836, every iron-work in Great Britain was visited by M. F. le Play, chief engineer to the Paris Board of Works, and he estimated the amount produced that year at 1,000,000 of tons. In 1840, Mr. Jessop found that there were 402 furnaces in England and Wales, in which 82, or 1 in 5, were out of blast; and out of 70 furnaces 6, or 1 in 11, were out of blast. The quantity of iron made in 1840, was 1,343,400 tons; but in consequence of the commercial depression, this fell to 1,046,428 tons in 1842, being a depreciation of 22 per cent. He next directed attention to the effect of railways on the price of iron. In 1836 and 1837, Parliament passed 77 railway bills, of which 44 were for new lines, and the aggregate of extent about 1,200 miles, requiring a production of more than 500,000 tons of iron. The price of bar iron which had been 6*l.* 10*s.* per ton in 1834, rose to 7*l.* 10*s.* in 1835, and in 1836 to 11*l.*; but in 1837, the railway speculation had so far subsided, that only 15 acts for new lines were passed from 1838 to 1843,—the price of iron fell more rapidly than it had risen, and during this period, iron could be sold with difficulty at less than half the price it commanded in 1836. The average price of iron at Glasgow in 1844, was 2*l.* 5*s.* 6*d.* per ton; in March 1845, it rose to 5*l.*; and in May to 5*l.* 10*s.*;—this rise in price of 175 per cent., gave such stimulus to production, that the make of pig-iron, in Scotland, for the first six months of this year, was 260,000 tons, or at the rate of 520,000 tons per annum;—the production having been doubled since 1840. It is the opinion of the iron-masters that since 1840, nearly all the increased production of iron in the kingdom has been drawn from Scotland. It appears that the demand created by the new railways, has stimulated every establishment to its utmost limits of production. But in order to add materially to the make of iron, a great many circumstances must concur. One of the chief difficulties arises from the workmen: skill is necessary, and the number of those properly trained is so limited, that they make demands for an enormous and disproportionate increase of wages on the first appearance of prosperity. Thus the cost of production seems to have more than kept pace with the rise of price. From this, combined, perhaps, with other causes, the amount of production in England for 1845 was only 917,500 tons, being 238,000 tons less than the production of 1840. From comparing several returns, it is clear that we have no reason to dread a failure of material,—some valuable and extensive fields of black-band ore having been recently discovered in Wales; but it seems not improbable that the Staffordshire iron-works will soon experience a deficient supply of coal. A new source of supply has been found in the refuse and waste of the lead mines of Weardale. The *rider* of the lead ore is a true carbonate of iron, yielding from 25 to 40 per cent. A small blast furnace has been erected, at Stanhope, for smelting this *rider*, and pig-iron of a strong and excellent quality has been produced. In consequence of this success, the company has commenced the erection of very extensive smelting works, near Walsingham. The difficulty then arises in the supply of labor. It is hopeless to stimulate the exertions of the persons already employed. They are naturally ready enough to exact higher rates of wages when the demand for their labor becomes more urgent;

but, succeeding in this, they prefer to obtain the same amount of earnings, with higher rates of wages, to the securing of greater gains by the exertion of even the same amount of toil;—so that a greater urgency on the demand, may be, and frequently is, accompanied by a lessened production. During the period of depression the low price of iron led to its being extensively applied to various purposes of construction in civil and naval architecture. On the subject of iron ships, Mr. Porter entered into some calculations to show their economy;—but the subject will be found more fully discussed in our report of the Paper read by Mr. Fairbairn before the Meeting of the British Association in Glasgow, in 1840. Up to the beginning of the present century, nearly two-fifths of all the iron used in this kingdom was imported from the north of Europe; but in 1806 this proportion had fallen to one-eighth, and foreign iron is now only imported for the manufacture of steel. Our exports, on the contrary, have so increased as to become an object of national importance.—

In 1827 we exported 92,313 tons, declared value, . . £1,215,561.
In 1845 " 351,278 " " " . . . 3,501,895.

The increase of our exports appears to be contingent on a reduction of price, and must, therefore, be materially affected by variations in the cost of production. Should the new railways stimulate a much larger production of iron, the quantity produced will greatly exceed the demand so soon as those railways are completed, and then prices will fall, perhaps to a lower point than has ever yet been witnessed. This will, probably, cause iron to be applied to many new purposes, and particularly to the construction of ships, fire-proof houses, and frame-work houses for exports to new settlements. All this, however, must be the work of time; and it seems but too probable that, in the meanwhile, our iron-masters will have to undergo a somewhat lengthened season of adversity,—for the enduring of which they are, in a measure, prepared, from former experience.

8. *On Plate Glass making in England in* 1846, *contrasted with what it was in* 1827; by Mr. H. Howard, (Proc. Brit. Assoc., from Athen., Sept. 19, No. 986.)—The writer furnished carefully all the materials for establishing this comparison. Amongst other results he stated, that in 1827 plate glass was sold for about 12*s.* average per foot, to the extent of about 5,000 feet per week; in 1835, for from 8*s.* to 9*s.* per foot, to the extent of about 7,000 feet; in 1844, for from 6*s.* to 7*s.* per foot reaching about 23,000 feet; and in 1846, for from 5*s.* to 6*s.*, —about 40.000 feet per week. The sale is now about 45,000 feet weekly. He mentioned that, in 1829, a plate glass manufactory ceased operations because of the small profits realized when selling at 12*s.*; while in 1846, a company with a paid-up capital of 130,000*l.*, realized a net profit of 30,000*l.*, selling at from 5*s.* to 6*s.* Looking at this extraordinary increase, in spite of the severity of excise restrictions, the author asks, what would be the probable demand if the price were reduced to 4*s.* or 3*s.* 6*d.* per foot—which, free as the trade now is from excise interference, would yield an ample profit?

9. *A Review of the Mines and Mining Industry of Belgium;* by R. Valpy, Esq. of the Board of Trade, (Proc. Brit. Assoc., from the Athen., Sept. 19, No. 986.)—Mr. Valpy stated that, as a coal-producing

country, Belgium ranked the second in Europe. The ratio of the coal district to the total area is

		Acres.		Tons annually.
Great Britain	$\frac{1}{20}$, or	2,930,000	producing	34,000,000
Belgium	$\frac{1}{22}$, or	335,000	"	4,500,000
France	$\frac{1}{31}$, or	630,000	"	3,783,000
Germanic Union	. . . . .			3,000,000

In 1838 the total number of coal-mines in Belgium was 307, with 470 pits in work and 172 in process of construction, employing 37,171 persons; being an increase of 8,454, or 28 per cent. on the number employed in 1829. The increase of the quantity of coal raised was not accurately ascertained, but it appeared to be about 37 per cent. The average cost of production is 10*s.* 8*d.* per ton, and the average price 23*s.* 1*d.* for first quality, and 16*s.* 6½*d.* for the second quality of coal; the average rate of wages is 1*s.* $6\frac{2}{10}$*d.* per day. The establishments for preparing other mineral productions for market in 1838 were, for iron 221, copper 8, zinc 7, lead 2; the total number of furnaces was 139, of which 47 used coke and 92 charcoal. The total number of accidents from 1821 to 1840 was 1,352, which occasioned severe injury to 882, and deaths to 1,710, making a total of 2,592 sufferers.

10. *On the Fairy-rings of Pastures;* by Prof. J. T. Way, (Proc. Brit. Assoc., Sept., 1846, from the Athenæum, Sept. 19.)—A description of these patches, with which most persons are familiar, was given by Mr. Way; and it was stated that the grass of which such rings are formed, is always the first to vegetate in the spring, and keeps the lead of the ordinary grass of the pastures till the period of cutting. If the grass of these fairy-rings be examined in the spring and early summer, it will be found to conceal a number of agarics, or "toad stools," of various sizes. They are found situated either entirely on the outside of the ring, or on the outer border of the grass which composes it. De Candolle's theory, that these rings increased by the excretions of these Fungi being favorable for the growth of grass, but injurious to their own subsequent development on the same spot;—was remarked on, and shown to be insufficient to explain the phenomena. A chemical examination of some Fungi (the true St. George's Agaric of Clusius—*Agaricus graveolens*) which grew in the fairy-rings on the pasture around the College at Cirencester, was made. They contained 87·46 per cent. of water, and 12·54 per cent. of dry matter. The ashes of these were found to contain: silica, 1·09; lime, 1·35; magnesia, 2·20; peroxyd of iron, trace; sulphuric acid, 1·93; carbonic acid, 3·80; phosphoric acid, 29·49; potash, 55·10; soda, 3·32; chlorid of sodium, 0·41.

The abundance of phosphoric acid and potash, existing, no doubt, as the tribasic phosphate of potash ($3KO, PO_5$), which is found in these ashes, is most remarkable. The author's view of the formation of these rings, is as follows:—A fungus is developed on a single spot of ground—sheds its seed, and dies;—on the spot where it grew it leaves a valuable manuring of phosphoric acid and alkalies—some magnesia and a little sulphate of lime. Another fungus might undoubtedly grow on the same spot again; but upon the death of the first, the ground becomes occupied by a vigorous crop of grass rising like a phœnix on the ashes of its predecessor. It would thus appear that the increase of

these fairy-rings is due to the large quantity of phosphated alkali, magnesia, &c., secreted by these fungi; and, whilst they are extending themselves in search of the additional food which they require, they leave, on decaying, a most abundant crop of nutriment for the grass.

11. *Gun-Cotton.*—The results of the deflagration of gun-cotton have been determined as follows by Messrs. PORRETT and TESCHEMACHER, as stated by them in a paper read before the Chemical Society, on Dec. 6, (Pharm. Times, Dec. 19, 1846.)

52·53 grains of gun-cotton gave 100 cubic inches of gas, constituted as follows:

	Relative volumes.	Cubic inches.	Grains.
Carbonic acid,	2	14·286	7·157
Cyanogen,	1	7·143	3·965
Nitric oxyd,	5	35·715	11·478
Carbonic oxyd,	5	35·715	10·714
Nitrogen,	1	7·143=100	2·184=35·070

One hundred grains of the gun-cotton would consequently afford 64·550 grains of the mixed gases. The other ingredients obtained from the same quantity were, water 20 grains, carbon 5, and oxalic acid 8·125.

Since the printing of the account of gun-cotton on page 259, we have received a notice of the session of the Academy of Sciences of Paris for January 4, (L'Institut, No. 679,) containing the later investigations of M. PELOUZE. His analyses have been numerous, and constant in their results. They give for *nitric cellulose* (or *Xyloidine*) the formula $C^{24}H^{17}O^{17}, 5NO^5$; and for *Pyroxyline* $C^{24}H^{20}O^{20}, 5NO^5, 5HO = C^{24}H^{17}O^{17}, 5NO^5, 8HO = C^{25}H^{21}O^{50}N^5$. As pyroxyline is shown by M. Richier to be entirely soluble in the acetic ethers of alcohol and spirits of wood, he was enabled to obtain it in powder, and in a state of purity proper for analysis. In the course of his investigations he analyzed *cellulose* and obtained Payen's result, $C^{12}H^{10}O^{10}$, or doubled (as Pelouze considers it) $C^{24}H^{20}O^{20}$. The composition obtained would imply that 100 parts of pure and dry cotton ought to give 174·9 parts of pyroxyline; and Pelouze found that it afforded 174 to 176 parts. He remarks that the gun-cotton dried at a temperature between 40° and 55° C. undergoes no sensible alteration. But towards 100° C. it gives out a very decided nitric odor and decomposes slowly. Between 100° C. and 110° C. it will lose in an hour a tenth by weight; at the same time it becomes yellowish and very friable, and often suddenly inflames. The combustion for analysis was made in the ordinary manner with oxyd of copper, and without the aid of any other substance besides metallic copper, which is necessary to destroy the nitrous compounds always produced in the elementary analysis of nitrogenous substances.

Pelouze states that the results of the detonation of pyroxyline may be represented as follows:—

46 volumes of carbonic oxyd, . = $C^{23}O^{23}$
2 volumes of carbonic acid, . = CO^2
10 volumes of nitrogen, . . = 5N
34 volumes of vapor of water, . = 17HO

besides the 8HO in the combination. These numbers, he adds, may

be varied by many circumstances, of which pressure and temperature are most prominent.

J. Mickle, Esq., of Camden, N. Y., has applied gun-cotton to the movement of machinery, and it is said with apparent success. The gun-cotton is ignited by electricity.

12. *Lines of Electric Telegraph in the United States and Canada.*—

From New York to Albany, via the towns on the eastern side of the Hudson,	150	miles.
" Troy and Albany to Buffalo,	350	"
" Buffalo to Toronto,	110	"
" New York to Philadelphia,	88	"
" Philadelphia to Baltimore,	115	"
" Baltimore to Washington,	40	"
" Philadelphia to Pittsburg,	317	"
" New York to Boston, via New Haven, Hartford, Springfield and Worcester,	238	"
" Boston to Portland, in Maine,	105	"
" Boston to Lowell,	26	"
" Boston to Albany,	200	"
" Toronto to Montreal and Quebec, (constructing,)	450	"
	2189	"

On nearly all the above routes the line is double, one wire communicating with each intermediate place, and one connecting the extreme points. It is probable therefore, that nearly or quite four thousand miles of wire have been put up in the United States, and lines are already contracted for, to connect Washington with Charleston and New Orleans.

13. *The New Botanic Garden at Cambridge, Eng.;* (Athen., Nov. 28, No. 996.)—This garden has been commenced, the Vice-Chancellor having planted the first tree on the west side, near the spot intended for the entrance on the Trumpington road. The Professor of Botany subsequently followed his example, by planting one on the east side of the garden. Twenty men are actively engaged in deeply trenching and levelling about seven acres of the ground, intended for the immediate reception of as many of the principal groups of the larger descriptions of trees as can be procured before winter. The Curator, who is zealously superintending the work, has found both the depth and quality of the soil much superior to what he had anticipated; and he considers even the poorest portions, towards the south-west angle, perfectly suitable to certain tribes. The gentle undulations over the whole twenty acres, and the introduction of a large sheet of water where the depression is greatest, will tend greatly to break whatever of formality it may be necessary to observe in the scientific grouping of the various objects that are cultivated in a botanic garden.

14. *Ray Society.*—The prospectus of this valuable institution will be found under the covers of this number of our Journal. The Council of the Ray Society have requested Prof. B. Silliman, Jr., to act as their Local Secretary for the United States, and he will receive and forward subscriptions, and will soon have copies of the Society's publications to deliver to those who want them. For the particulars of titles, terms, &c., see the prospectus in our November number and also in the present.

15. *On the Duration of Life in the Members of the several Professions, founded on the Obituary Lists of the Annual Register*; by Dr. Guy, (Proc. Brit. Assoc., from Athen., Sept. 26, No. 987.)—The following table exhibits the average of such as had attained or outlived the ages specified:—

Age.	Army.	Navy.	Clergy.	Law.	Physic.	Learned Professions.	Fine Arts.	Literature and Science, English.	Literature and Science, Foreign.	Trade and Commerce.	General Average of England and Wales.	Nobility and Gentry.	Casper's Table of Medical Profession.
26 and upwards,	65·27	67·63	68·81	66·20	65·36	67·70	64·42	66·49	62·78	68·11			58·00
31	67·07	68·40	69·49	68·14	67·31	68·86	65·96	67·55	66·72	68·74			59·27
41	68·97	70·01	71·82	70·20	70·23	71·24	68·21	69·15	68·42	71·01			63·82
51	71·58	72·62	74·04	72·78	72·95	73·62	71·15	72·10	71·44	72·32	75·64	74·00	68·21

If we confine our attention to the last line of the table, we shall see that the duration of life among the higher classes is shorter than that of the mass of the people of England and of the provident members of the laboring class. In every age the navy possesses a very slight advantage over the army. The longevity of the clergy is superior to that of any of the other learned professions. The less favorable duration of medical life, in the tables published by Prof. Casper, of Berlin, is to be attributed to his having included a lower grade of the professions than those whose deaths are recorded in the Annual Register, probably such a class as the general body of medical practitioners in England. Both however show that medical men encounter the most danger at the early part of their professional career, and this is more apparent when the column of medical life is compared with that of law life. From his own and other tables Dr. Guy constructed the following summary at 51 and upwards:—

English males,	75·64	Army,	71·58
Clergy,	74·04	Foreign Literature and Science,	71·44
Gentry,	74·00	Fine Arts, &c.	71·15
Medical men,	72·95	Painters,	70·96
Lawyers,	72·78	Chemists,	69·51
Navy,	72·62	English Literature (according to Chambers),	69·14
Trade and Commerce,	72·32	Members of Royal Houses (males),	68·54
English Literature and Science,	72·10	Kings of England,	64·12
Aristocracy,	71·69		

The brief discussion which ensued, turned chiefly on the value of the obituary of the Annual Register;—which, some thought, had not the uniformity necessary to furnish data sufficiently precise for the construction of tables.

16. *On the Mortality of Children;* by Mr. Wigglesworth, (Proc. Brit. Assoc, from the Athen., Sept. 19, 1846.)—It appeared that returns had been collected from 1987 families, in which the number of children was 10,076, giving an average of more than five in a family. The number of males was 5,091 and of females 4,985 which gives a proportion of fifty-one to fifty. From these Mr. Wigglesworth constructed a table, showing the number out of which one child would die in one year according to the experience of families.

Age.	Males and Females.	Males.	Females.
1	9·62	8·34	11·40
2	16·88	17·01	16·75
3	32·38	31·00	33·63
4	47·14	49·32	45·25
5	65·51	67·21	63·94
6	90·38	108·85	77·59
7	95·83	83·21	112·48
8	143·14	120·52	174·80
9	137·80	124·53	153·56
10	281·63	369·67	228·80
11	155·93	160·16	152·00
12	196·05	193·20	199·70
13	279·38	356·20	231·37
14	195·88	271·16	154·82
15	153·70	165·33	144·18
16	200·14	123·63	480·67
17	171·67	176·57	167·37
18	190·25	158·43	242·00
19	162·15	166·67	158·28
20	158·00	101·67	327·00
21	121·43	138·67	108·50

Taking the case of males and females conjointly, it will be seen that there is a gradual decrease from the 1st to the 8th year, and that there is an increase over the previous year in the 9th, 11th, 14th, 15th, 17th, 19th, 20th, and 21st years.—In males these fluctuations take place in the 7th, 11th, 14th, 15th, 17th, 19th, and 21st years.—In females there is a general decrease to the 8th year, and an increase in the 9th, 11th, 14th, 15th, 17th, and 21st year.—A table of diseases was then exhibited, from which it appeared that more males than females died of nervous diseases and from external causes; but that more females than males die of epidemic disease, and diseases of the respiratory organs.—These tables, from family returns, were then compared with similar tables constructed from the statistics of the Foundling Hospital, and were found to agree very closely in their results.

17. *Monument of the late* Thomas Say.—It gives us great pleasure to announce, that Mr. Alexander Maclure, the venerable and worthy brother of the late Mr. William Maclure, has ordered a neat and appropriate monument to the memory of Thomas Say; a man whose remarkable attainments in science, amiable heart, and elevated character, have associated his name with many delightful remembrances.

The monument has been executed in Philadelphia by those excellent artists, John Struthers & Son, and is now on its way to New Harmony, in Indiana, where Say died and is buried, and where Mr. Maclure resides.

Presuming that this testimonial to departed worth, will be regarded with interest by all who knew the subject of it, as well as by every lover of science, we subjoin an outline drawing of the monument, (which is of white Italian marble,) with a copy of the inscriptions on the four sides of the shaft.

(1.)

THOMAS SAY,
The Naturalist.
Born in Philadelphia,
July 27, 1787;
Died at New Harmony,
October 10, 1834.

(2.)

One of the Founders
Of the
Academy of Natural Sciences
of
Philadelphia,
January 25,
1812.

(3.)

Votary of Nature even from a child,
He sought her presence in the trackless wild;
To him the Shell, the Insect, and the Flower,
Were bright and cherish'd emblems of her power;
He saw in her a spirit all divine,
And worship'd like a pilgrim at her shrine,

(4.)

The Friend and Companion
of
William Maclure;
Whose Surviving Brother
Erected this Monument,
A. D. 1846.
A. M.

VI. Bibliography.

1. *Chemical Examination of the Urinary Calculi in the Museum of the Medical Department of Pennsylvania University;* by Robert Peter, M. D., Lexington, Ky., 1846.—This research embraced eighty-one specimens, of which seventy-eight were from the human subject; two from hogs, and one from a jackass. The State of Kentucky appears to furnish a remarkable number of calculi, owing probably to the prevalent use of maize and bacon as articles of food, both of which abound in earthy phosphates, while the waters of the same region are generally impregnated with salts of lime. Dr. Peter estimates one case of calculi to 16·050 of the inhabitants of Lexington, while in Ireland (pauper population) it is estimated by Dr. Yelloly as 1 in 875·000 per annum.

Among the specimens examined by Dr. Peter, are two of the very rare *cystic oxyd* weighing half and three-quarters of an ounce each.

The specimens were all sawn through the nucleus by a fine saw and the cortex and interior separately examined. Of the 78 calculi, the composition of the nucleus was uric acid mainly in 32, urate of ammonia in 26, oxalate of lime in 7, phosphates in 7, foreign substances in 4, cystine 2. The *bodies* are composed of uric acid mainly in 34, urate of ammonia in 2, oxalate of lime in 16, mixed phosphates in 16, triple phosphates in 4, cystine in 2.

The peculiarities presented by the Lexington collection, are a great deficiency in the proportion of pure uric acid in the nuclei, a great excess in the proportion of nuclei containing urate of ammonia and the earthy phosphates found in their general composition, an excess in the proportion of the mulberry or oxalate of lime calculus. Only a very small proportion of the cases of calculi occurring in the vicinity of Lexington have been preserved.

2. *Coast Survey: Report of* Prof. A. D. Bache, *Superintendent of the U. S. Coast Survey, showing the progress of that work for the year ending, Nov.* 1846. H. of Reps., U. S., Doc. No. 6.—This important national enterprize has given, under the administration of its present head, substantial proof of progress. It is now recognized as an object of the first importance to bring out the results of the survey as fast as possible, consistently with accuracy. This answers the double end of rendering their labors, in the highest degree, useful, and at the same time the best evidence is afforded of zeal and activity in the prosecution of the work.

The whole of our vast sea coast line has been divided into nine principal sections, in each of which the work is separately prosecuted by the several surveying parties. Of these the second section—from Point Judith to the Capes of the Delaware—is in general, completed, and the work is already in good progress in six others. The primary reconnaissance is first made, next follow the triangulations and astronomical observations—which prepare the way for the topographical and hydrographical parts of the work, so that the progress is one of increasing activity from the reconnaissance forward, until all the objects of the survey are embraced. It is easily seen that by this plan the survey of the whole coast may be completed within a very limited period of time, the number of sections under survey at the same time, determining the period of completion of the whole work. The publication of maps and charts goes on simultaneously, and the experience of the past two years shows that five or six sheets can be published within the year,—two or three sheets of general coast maps and three or four of harbor maps. The style of these maps is in all respects admirable, as all will agree who have had an opportunity of inspecting those which have been already published.

The hydrographical party under Lt. Commanding Davis, made the important discovery, during the past season, of an extensive shoal off the eastern end of Nantucket lying directly in the track of communication to and from Europe, and upon which, not improbably, the ill-fated "President" steamer stranded. This dangerous shoal has hitherto been quite unknown, except to the lost.

A melancholy interest is given to this Report by the loss of Lieutenant Commanding George M. Bache, and ten seamen from the survey-

ing brig Washington, on the 8th of September. They were washed overboard during a terrific hurricane, with nearly all on deck, while the brig was knocked on her beam ends, dismasted: all but the commander and the ten unfortunate seamen succeeded in regaining the vessel.

Capt. Bache (who was a brother of the superintendent) was charged with a survey of the Gulf Stream, and had made three sections across it, between Barnegat and Cape Hatteras, determining with great exactness, its temperatures from the surface to great depths, (even in one case as deep as 1500 fathoms,) and investigating many other points of high scientific interest. We are left to deplore his loss as one of the most experienced and scientific naval officers in the service. He had passed nine years in the duties of the coast survey, and his name appears on every chart they have published, save one. A medal has been ordered by the Treasury Department commemorative of his heroism and of the sad disaster which removed him with his ten companions, from the scene of his usefulness. He perished nobly, in the able and faithful discharge of his duty; and the execution, after his loss, of the last order he gave at the moment he was washed off, insured the safety of the vessel, and of the surviving officers and crew.

The present report is accompanied by nine maps illustrating the progress of the work during the past season.

3. *Light Houses: Report of the Secretary of the Treasury on the Improvements in the Light House System and Collateral Aids to Navigation, embracing a Report from* Lieut. THORNTON A. JENKINS, U. S. N., *and* Lieut. RICHARD BACHE, U. S. N. Washington, 1846. 8vo. pp. 272, with a folio atlas of twenty-seven plates.—This Report embraces a full account of the light house systems of Europe, especially of England and France. The system of catopteric lights devised by the elder Fresnel and continued by his brother, is now universal on the French coast. Lts. Jenkins and Bache enjoyed the best advantages for becoming familiar with all the details of this perfect system of illumination, under the immediate auspices of Fresnel, now superintendent of light houses in France. This Report, it is to be hoped, will induce a great reform in this very important arm of our national service, which we are under the highest obligations of interest and philanthropy to maintain in the greatest possible perfection. We have read this Report with much interest, and regret that we have not space to make extracts from it.

4. *Journal of* Lieut. J. W. ABERT, *from Bent's Fort to St. Louis, in* 1845. 75 pp., 8vo, with maps and sketches. Ordered to be printed by the United States Senate.—The Expedition of Lieut. Abert commenced in the Rocky Mountains, in lat. 38°, and lon. 103° 30′, from which place he took charge, by the order of Capt. Frémont, of the survey of Purgatory creek, and the course of the Canadian, and False Washita. The party followed up Purgatory creek, and left its head waters for the source of the Canadian, down which they continued their survey and observations. Lieut. Abert's Journal contains much valuable information relative to the Camanche Indians, and many characteristic incidents are told of these wild warriors of the mountains. Many facts are also related regarding the natural history of the region. We gather from his pages that a soft brown sandstone, probably the

same observed to prevail so extensively farther north by Major Long, was the rock in the vicinity of Purgatory creek, and along the Canadian in latitude 36°. The beds were nearly horizontal and highly ferruginous, and occasionally much intersected by seams of iron. The rock forms high bluffs, bounding the valley of the Purgatory; numerous impassable ravines intersect it occupied usually by torrents dashing wildly over a succession of rocky ledges. The water of the region was in standing pools, generally impregnated with common salt and other salts, rendering it nauseous and bitter to the taste. From latitude 36½° to 36°, on the Canadian, there were bluffs of shale. Below this they passed to the soft brown sandstone again, and then to a red sandstone of a bright red color, which, in longitude 103°, was overlaid by a limestone. Pools of salt waters were here met with; and between the meridians of 98° and 102° there were beds of gypsum, besides handsome crystallizations of this mineral in the red clay banks. Near longitude 102° several petrified trees were observed, which were covered in part with quartz crystals; in some places the fibre had been replaced by pink colored agate, which gave a beautiful effect to the brilliant display of crystals above. The plains were strewed with coarse agates.

5. *Chloris Boreali-Americana*: Illustrations of new, rare, or otherwise interesting North American plants, selected chiefly from those recently brought into cultivation at the Botanic Garden of Harvard University; by Asa Gray, M. D., Fisher Professor of Natural History in Harvard University. Decade I. (From the Memoirs of the American Academy of Arts and Sciences, Vol. iii, New Series.) 56 pp. 4to, with colored plates. Cambridge, 1846.—This valuable memoir is the first of a series in the course of preparation, designed to illustrate the more obscure parts of North American Botany, by the description and illustration of new or imperfectly known species. A list of those described in this Decade is inserted in our last number, page 151. The descriptions are given with fullness, and with that discrimination and critical accuracy, which characterize all the botanical writings of Prof. Gray. The plates contain detailed dissections, and besides their scientific value they are exquisite specimens of art. The American Academy of Arts and Sciences falls behind none of the societies of Britain or Europe in the stile and merit of their recent memoirs.

6. *Nomenclator Zoologicus, continens Nomina Systematica Generum Animalium, tam viventium quam fossilium, etc.; Auctore* L. Agassiz. Fasc. 1–10, (Soleure, 1842–46,) 4to.—This great work, which must have cost an extraordinary amount of labor, is now almost completed. Trusting that some one of our able zoologists will duly give an account of a work which is indispensable to every votary of their science, we propose at this time merely to call attention to the preface, published last year with the 9th and 10th fasciculi, and to express unqualified admiration of the manner in which a subject of interest to all naturalists, that of nomenclature, is there treated. While botanists are enjoying the benefits of a sedulous adherence to the wholesome rules imposed by the father of natural history nomenclature, and of nearly unanimous agreement in the few changes which the progress of science and the multiplication of its objects have rendered needful, the zoologists on the

other hand, who have too generally allowed every one to do that which was right in his own eyes, are reaping in consequence a plentiful harvest of confusion. The difficulty of a reform increases with its necessity. It is much easier to state the evils than to relieve them; and the well-meant endeavors that have recently been made to this end are some of them likely, if adopted, to make "confusion worse confounded." Probably no living zoologist is so conversant as Prof. Agassiz, with the actual state of the nomenclature of the animal kingdom, and so well qualified to judge of the practical working of proposed rules, which often involve consequences that the propounders never dreamed of. Our author's views are therefore entitled to great weight. We are glad to perceive that they entirely concur with those quite unanimously adopted in the other great department of natural history, for which the Linnæan canons were originally framed. As these canons were the foundation of our nomenclature, Prof. Agassiz has very properly reproduced them, *totidem verbis*, from the *Philosophia Botanica*, adding now and then a short but pithy commentary. He then proceeds to examine the rules proposed by the Committee of the British Association, and shows that while some of them are mere iterations of the Linnæan canons, which should never have lost their authority, others are contrary to them, or threaten greater evils than they are intended to remedy. In most respects his criticisms concur with those already made by Dr. Gould in a former volume of this Journal, (xiv, p. 1.) We agree with Prof. Agassiz in thinking these English canons worthy of adoption only when they agree with the letter or spirit of the Linnæan rules, which indeed they generally do. Those which conflict with them have not received, and probably will not receive, the general assent even of British naturalists. Hence, in our opinion, the American Geological Association has too hastily reaffirmed them, while they have, indeed, improved their form in several respects. It may be well to notice the comments of Prof. Agassiz upon the more objectionable propositions.

Their first rule, "that the name given by the founder of a group or the [first] describer of a species should be permanently retained," cannot be too firmly insisted on; for upon it rests the stability which is the most essential requisite of nomenclature. Their second rule, that since "the binomial nomenclature originated with Linnæus, the law of priority is not to extend to the writings of antecedent authors," restricts the former too arbitrarily, and conflicts, as Prof. Agassiz states, both with the canons* and the example of Linnæus, not less than with the conscientious practice of good naturalists ever since. Linnæus was not the founder of *genera* or of *generic* nomenclature, and "far from making new names in every instance, he retained all names given by his predecessors, provided they could be received into his system." It is generally thought that Linnæus erred by adopting, not too many, but *too few* of the unobjectionable and well established generic names of his predecessors, such as Tournefort, &c. Now when, in the natural progress of the science, a Linnæan genus is resolved into two or more Tournefortian ones, for instance, are the names of Tournefort to be

* § 241. *Nomina generica Potrum Botanices, Græca vel Latina, si bona sint, retineri debent, ut etiam usitatissima et officinalia.*—Also vid. § 239.

excluded from use? In the breaking up of the Linnæan genus *Lonicera*, had not the Diervilla and Xylosteum (and if the division were to go farther, the Periclymenum and Caprifolium) of Tournefort, as well as the Symphoricarpos of Dillenius, an indisputable right to restoration? Indeed Linnæus was here plainly wrong in not adopting one of these prior names for the whole genus, instead of creating the new one. This, however, was to be submitted to; for, as Prof. Agassiz remarks, "the names sanctioned by Linnæus are to be held as established above all others. Linnæus, for instance, received very few genera of *Echinodermata*. Now-a-days this class numbers many, among which some of those founded by Klein, Link and Breynius, long anterior to Linnæus, hold their place with the modern ones of Lamarck, Müller, &c. But no one now prefers that new names should be made for such genera, rather than that such approved anterior ones should be brought into use again. I certainly see no cause why we may not call to life the names of former authors when we divide the genera of Linnæus." We think those naturalists blameworthy who do not.

The third, fourth and fifth, of the British canons are accordant with Linnæan rules, and are regularly followed in botany. The next four relate to matters which follow as a consequence of the law of priority; but as to what relates to the use of synonymous names, Prof. Agassiz intimates that their rule is perhaps too absolute, and even contradictory to the Linnæan canon, § 244. "*Nomina generica, quamdiu synonyma digna in promptu sunt, nova non effingenda.*"

The tenth rule, viz. "A name should be changed which has before been proposed for some other genus in zoology or botany, or for some other species in the same genus, when still retained for such genus or species," is not as well worded as the equivalent Linnæan canon, § 217, "*Nomen genericum unum idemque ad diversa designanda genera assumptum, altero loco excludendum erit.*" Mr. Agassiz remarks, greatly to our surprise, that the enforcement of this rule would demand the sacrifice of almost half the generic names made in recent times. In our opinion, while the same names *ought not* to be given both in zoology and botany, the time is passed when received names are to be changed on this account. While writers in the different departments of zoology alone, have doubly employed the same name "in ten thousand instances," we must see that cases of this sort between zoologists and botanists, occupying such widely separated fields, are inevitable, at least until as perfect lists of zoological names shall be compiled and kept up as is done in botany. Besides it is now utterly impossible for any single naturalist, or any joint committee of botanists and zoologists to determine, in half of the cases that arise, whether a particular genus is to be suppressed or retained in one department, so as to require or forbid a change of the posterior homonymous name in the other; hence the practical application of the Linnæan rule would now create tenfold more confusion than it can relieve. Each well founded change of the sort does no more than to obviate a possible inconvenience, while every needless one, in a genus of numerous species, draws after it a load of useless synomyms, which do not serve, like genuine synonyms, to tell the history of the genus and mark the progress of our knowledge. The whole subject is forcibly presented by Prof. Agassiz, in another section

of his preface, (p. xxviii, *et seq.*,) where he states that he now knows three thousand generic names common to botany and zoology, which the Linnæan rule would require to be changed in one or the other department. But surely this number must comprise a host of synonyms long since fairly laid on the shelf, as well as names of somewhat different formation or termination, although of the same derivation. In this case a small matter should give them impunity. If these changes must be made, no one could do the work for zoology better than Mr. Agassiz; but he affirms it to be a task quite beyond his power, and justly concludes that, "in the present state of the science, generic names ought not to be changed solely on account of their being employed in both kingdoms of nature." To this conclusion the American Association evidently accede.

As to generic names doubly or triply* employed in the several classes of the animal kingdom, (which, we are astonished to learn, already number *nearly ten thousand!*) the necessity of applying the Linnæan canon is obvious, and would be imperative had not the evil reached such a height as to baffle the remedy. The *summum jus* which demands the immediate change of nearly a moiety of the received zoological names, would surely become *summa injuria* to the science, even if any naturalist were equal to the task of applying it. Justice must here be delayed, in order that it may be rightly administered, and, as our author recommends, the business of gradually bringing this part of nomenclature under the rule, must be left to monographers and future systematists. But let those upon whom the *cacöethes nominandi* is strong, obey our author's advice, desist from proposing new names in mere catalogues, and never attempt, while revising the genus which rightfully claims a particular name, to impose new names upon the homonymous genera in other classes, but leave that for their own respective monographers. It will be soon enough to give them new names, if such are needed, when the validity of these several genera is well made out.

Upon the 11th rule of the British Committee, namely, that "a name may be changed when it implies a false proposition which is likely to propagate important errors," Prof. Agassiz remarks that the less this liberty is used the better, lest it should lead to licentiousness.

The 12th rule ordains that "a name which has never been clearly defined in some published work should be changed for the earliest by which the object shall have been so defined." This law, our author remarks, "has become very necessary, since dealers in natural objects have begun to arrogate the authorship of books collected from catalogues, and demand that authors shall receive their names for dividing species. It is the same with names which remain unpublished in public or private collections, and to which the proprietors or curators sometimes lay claim. But priority is to be conceded only to publication in a work which is accessible to the learned throughout the world. Yet while we strictly press the observance of this law in respect to the publication by

* As a specimen of the carelessness of zoologists, the name *Cuviera* is employed as a genus not only in botany, (where it has priority and good taste in its favor,) but also among Medusæ, Echinodermata, Crustacea and Mollusca.

learned men of the results of their observations, so much the more must we brand with infamy those impudent parasites who prowl about museums to pick up materials for their *opuscula*, without mentioning the sources whence they have derived their spoil, and sometimes even furtively describing the species, the names of which they claim." The people alluded to well deserve this censure. On the other hand, not less blameworthy are those who purposely pass by, instead of courteously adopting, appropriate names under which naturalists often distribute their specimens in advance of publication. This felony is the more atrocious, because remediless, and to be prevented by no rule except that of courtesy; for the public good requires that priority should be conceded to actual publication alone.

The two remaining laws (13th and 14th) are agreeable to, or identical with, Linnæan canons, and are approved by all good naturalists.

The rules recommended by the British Committee, for the future improvement of nomenclature, are next considered; and as they are far the most commendable and in general use among good naturalists, we shall only notice those that Mr. Agassiz criticises, or we have occasion to comment upon. The writer of the British Report has chosen to enforce the direction, to avoid harsh and inelegant or sesquipedalian names, by citing as an example of the kind, the "*Enaliolimnosaurus crocodilocephaloides* of a German naturalist;" for which he is strongly censured by our author, who declares that no naturalist has ever proposed this name. Surely, if any one is inclined "to cast stones into his neighbor's garden," as our author says, there is no lack of legitimate opportunity, nor necessity for fabricating hard names.

The British Committee condemns the future employment of generic names which have been superseded by the rule of priority. But this is contrary to the canon, § 245—"Nomen genericum unius generis, *nisi supervacaneum*, in aliud transferri non debet," (and to *obs.* under § 244,) no less than to the practice of Linnæus and of subsequent naturalists. For instance, *Saururus* of Plumier became a synonym of *Piper*, but this did not debar Linnæus from the subsequent application of the name to a new genus. *Sisyrinchium* of Tournefort being included in *Iris*, Linnæus gave the name to a different genus; nor did he hesitate to adopt the genus which Ellis had dedicated to Hales, on account of an earlier *Halesia* of Browne, which had already sunk to a synonym. Why should a good name be forever *tabooed* in such cases, and why not, if occasion offers, allow it to be remarried to a new genus? We should be careful, however, not to re-produce names which are likely ever to be resuscitated in their former relation.

The British Committee objects to the practice of giving to a genus the name which it bore as a species of a former genus. But, as Prof. Agassiz justly remarks, when a species, which proves to be the type of a new genus, has a good proper name already, it seems quite as admissible to take that name for the genus and make a new one for the species, as to coin a new generic name, since either way a new name must be introduced: indeed it is preferable, because such Linnæan species frequently are found to comprise several, hitherto confounded, no one of which has a paramount claim to the specific name; e. g. *Cyprinus Gobio*, *C. Leuciscus*, *C. Barbus*, L. We go further, and main-

tain that *proper* specific names are, *cæteribus paribus*, always to be preferred for genera in these cases, not only because they are already familiar, but because they are most frequently old generic names which may claim under the law of priority. For example, *Lonicera Diervilla*, L.=*Diervilla*, Tourn.; *L. Symphoricarpos*, L.=*Symphoricarpos*, Dill.; *Rhamnus Paliurus*, L.=*Paliurus*, Dod.; *R. Zizyphus*, L.=*Zizyphus*, Dod.; *Rubus Dalibarda*, L.=*Dalibarda*, L.; and so of hundreds of proper specific names which have rightly resumed their generic rank.

The next proposition of the British Committee, namely, that specific names, even when substantive or borrowed from persons or places, should uniformly be written with a small (instead of capital) initial, is so contrary to long usage and offensive to good taste, that we are surprised it should anywhere find favor. Mr. Agassiz pointedly condemns it. The only reason assigned for the change is that some people might not be able to distinguish the specific from the generic name, without the aid of typography. But, as Dr. Gould has already remarked, in this Journal, such persons would be misled by almost anything; and the propounders of the rule should follow it consistently by writing their own cognomen with a small initial letter. We do not wonder that the Committee of the American Association refused to reaffirm this rule, as applied to proper names from persons; and we are quite sure that naturalists generally will not hesitate wholly to reject it. Surely the committee would not approve the practice of a late botanical author of this country, who reduced the proper specific names of Linnæus into adjective conformity, by writing "*Ranunculus flammulus*," instead of R. Flammula, "*Thymus serpyllus*" in place of Thymus Serpyllum, and so on.

Prof. Agassiz severely condemns the proposition to restrict the names of families to a uniform termination in *idæ*, and their subdivisions to *inæ*, without considering whether the words in question will receive that particular suffix kindly. This is quite too straight-laced, and gives rise to many awkward forms, or

> "Sesquipedalia verba
> Vel nocitura sono, guttur læsura loquentis,"

which it is not worth while to encounter *needlessly*, for the sake of mere technical uniformity, at least when they may be avoided by some liberty of choice in the mode of prolongation.

The proposition, D. of the British Committee, which directs that the name of the original propounder of a species should continue to adhere to it when transferred to a different genus, is warmly defended by some naturalists in England and, in a modified form, in our own country also. Few naturalists are now so well qualified to judge of the practical operation of this scheme, as Prof. Agassiz. He declares his opinion that, if received, "it will introduce horrible and remediless confusion," and that no possible multiplication of synonymy is likely to lead to so many difficulties, as this new practice. He therefore strenuously opposes it by arguments drawn from the precepts and practice of Linnæus, who meant the specific name to be subordinate to the generic, and never intended it to be inferred, that he who applied to a plant or animal a

certain name, was therefore its discoverer, or even its first systematic describer. He affirms that Linnæus would have expressly rejected "*Tyrannus crinitus*, Linn. (*sp.*)," were the innovation proposed in his days, and have written *T. crinitus*, Swains., had he thought best to approve the division of his genus *Muscicapa*. On the other hand, if he disapproved the division, we may add, he would not have thanked a contemporary for making him seem to adopt it. The hardship is still greater when the question is not of the division of an old genus, but of the proper place of a species among admitted genera, when it is surely improper to cite an author as referring it to one genus, while he expressly maintains that it belongs to another. In fact, the remedy is much worse than the disease which the English doctors would cure. Linnæus maintains that he is the true naturalist who understands genera; but from the new practice it will inevitably follow, as Prof. Agassiz asserts, that the proper establishment and definition of genera, which demands the highest powers of the naturalist, will be less esteemed than the mere distinguishing of species; a result which, far from promoting science, will especially retard the progress of that part of zoology in which there is most to be done, and in which the science of the animal, is still far behind that of the vegetable kingdom. It is of the greatest importance that we should be able to thread our way back through entangled synonymy and mistaken references, to the original sources. Here our difficulties would be greatly multiplied, unless two sorts of synonyms are used. For who, as Mr. Agassiz says, can find out what Linnæus has said of *Muscicapa crinita*, without a direct reference to the genus in which Linnæus himself placed it? And when, as often happens, the Linnæan species is mistaken, so that the *Tyrannus crinitus*, Linn. (*sp.*) according to Swainson, is not the *T. crinitus*, Linn. (*sp.*) according to some other author, the confusion becomes inextricable, unless we encumber ourselves with two modes of annotation, the old for expressing synonymy, and the new for the names really adopted. "Then the two modes will not agree with each other, nor can one know whither to turn himself. Surely the authors of this new rule cannot have duly considered these inconveniences, else they would have themselves discarded it. Therefore I entreat and pray them, by all the interests of the science they wish to promote, to abandon their proposition, and not to introduce a new schism into natural history, but to return again to the system of Linnæus, the most simple of all, and least liable to errors and Babylonish confusion in nomenclature."

The Committee of the American Association more wisely adopted the mode, afterwards employed by Mr. Dana in his great work on zoophytes, namely, that of appending to the specific name the original authority for the species in brackets, and adding without brackets the name of the author who has first described the species under the later received genus. To this plan there can be no objection, except that it is rather cumbrous, if it is to be used in every brief mention of the species, and, in our opinion, quite superfluous in a systematic treatise, where the synonymy is given in proper historical order.

The recommendation to make sub-generic names agree in gender with that of the genus, Prof. Agassiz thinks is of no consequence, unless the new annotation, just animadverted upon, should come into use.

Besides it would often interfere with the rule of priority, which requires synonyms, when they exist, to be adopted for sectional names. But he strongly commends the rule, that the etymology of names should always be stated by the proposer.

Justly does Mr. Agassiz condemn the practice of those who change the authority of a genus, when they extend or narrow its bounds, or correct a faulty orthography. Thus he would write *Lepidosteus*, Lacep., although Lacepede wrote *Lepisosteus;* and especially would he write *Perca*, Linn. (Cuv.), not *Perca*, Cuv.

Hearty and just, also, is his censure of the custom of those French zoologists, who use vernacular appellations in scientific works, either to the exclusion of the systematic name, or in precedence of it.

Our author closes this part of his preface with some excellent reflections on the study of genera in the animal kingdom, and the need of a thorough re-investigation of the grounds upon which natural families are constituted; remarks which we would gladly copy, if our limits allowed. A. Gr.

7. *Beiträge zur Pflanzenkunde des Russischen Reiches; herausgegeben von der Kaiserl. Acad. der Wissenschaften.* (Contributions to the Botany of the Russian Empire, published by the Imperial Academy of Sciences.) St. Petersburg, 1845, 8vo.—The fascicles which we have received contain the following papers, by Dr. Ruprecht, viz: 1. *Flores Samojedorum Cisuralensium*, pp. 67, with six folio lithographic plates. The plants here described are the fruits of an exploring tour made by Dr. Ruprecht himself, in the summer of 1841, to the arctic coast and islands between the White sea and the northern extremity of the Ural mountains. They are particularly interesting for comparison with the arctic and subarctic vegetation of our own continent. When the ampler collections of Middendorf, who has largely explored the country of the Siberian Samoieds, come to be published, and which are said to resemble those of Melville Island, &c., though much more numerous in species, the botany of the arctic kingdom round the world may be said to be pretty well known. For the Linnæan *Arenaria peploides*, Ruprecht has restored the forgotten name of *Ammadenia*, conditionally proposed and perhaps sufficiently characterized by Gmelin nearly twenty years anterior to the uneuphoneous name of *Honckenya* of Ehrhart. Though it were to be wished, that Ehrhart had adopted this name, it is now too late to revive it.—2. *Distributio Cryptogamarum Vascularium in Imperio Rossico*, pp. 56. An interesting tract. It seems that the Siberian specimens of the Linnæan *Asplenium rhizophyllum*, belong to a new species of *Camptosorus;* and also that *Botrychium Virginicum* is a native of Russia proper. Dr. Ruprecht has added some new species of *Allosorus*, and given an arrangement of the genus under three subgenera; but his third group *Homopteris*, founded for *A. Stelleri* and *A. gracilis*, is probably not stable, for our *A. gracilis* certainly does not accord with the character "*Frondes omnes consimiles.*" Our author has also a good revision of *Woodsia.*—3. *In Historiam Stirpium Floræ Petropolitanæ Diatribæ* (pp. 93); a critical enumeration of the plants which grow around St. Petersburg; with a historical and interesting geographico-botanical preface. *Botrychium simplex* of Hitchcock, published in this Journal, or a plant extremely near it, has been detected near St. Petersburg. A. Gr.

8. *Report on the Trees and Shrubs growing naturally in the Forests of Massachusetts;* by Geo. B. Emerson. Boston, 1846. pp. 534, large 8vo, with seventeen plates.—This volume worthily finishes the able series of Reports by the Commissioners on the Zoological and Botanical Survey of the State of Massachusetts. Our limits will not permit us to give here the detailed account which the work deserves. We can only say, that an attentive perusal has confirmed our impression that the work is a model for a popular, and yet truly scientific, treatise upon trees and shrubs. The volume is replete with the most valuable information, obtained by the protracted personal observation and research of a genuine lover of trees and plants, carefully digested, and presented in a form which, for the end in view, leaves nothing to be desired. A. Gr.

9. *Botanical Magazine*, for January, 1847.—Sir Wm. Hooker has devoted this number entirely to the illustration of the *Victoria regia* of Central America, a gigantic water lily, and perhaps the most magnificent and wonderful vegetable production in the known world. One plate, taken chiefly from Schomburgk's "Views in British Guiana," is a reduced representation of the plants *in situ*, the enormous leaves and flowers covering the surface of a pool or placid lake, bordered by palm trees and other tropical plants. The next plate represents the flower of the natural size—a foot in diameter—from a specimen preserved in spirits, and brought from Bolivia by Mr. Bridges. Two other plates are devoted to dissections of the flower, which does not very essentially differ from that of Nymphæa, except in the higher cohesion of the floral envelops. Sir Wm. Hooker has not been able to examine the fruit. We are curious to know whether the seeds have an arillus, like Nymphæa, and regret that no analyses of the seed were made. Perhaps we ought not to regret that no seeds were sacrificed, however, since we are informed that those brought to England by Mr. Bridges have germinated in the conservatories of the Royal Botanic Gardens at Kew, and we may hope that Sir William may succeed in bringing the wonderful plant into flower. A. Gr.

10. *A Treatise on Algebra, containing the latest Improvements; adapted to the use of Schools and Colleges;* by Charles W. Hackley, S. T. D., Professor of Mathematics and Astronomy in Columbia College, New York. 504 pp., 8vo. New York, Harper & Brothers. 1846.—Professor Hackley in the work before us, has presented the American public with the most complete Treatise on Algebra in the English language. The elementary principles are treated in a simple and easy style, and from these the student is conducted to the higher branches of the subject, in which all that is important is lucidly detailed. The author remarks in his preface, "the French treatises furnish excellent models of the theory of Algebra, the German of ingenuity and brevity of notation and exposition, the English of practical adaptation and variety of illustration and example; and from these, after a careful comparison of many authors in each language, demonstrations have been selected and introduced verbatim when they seemed incapable of improvement; but whenever the slightest alteration or amalgamation, or the entire remodeling of them, could give additional clearness or elegance, the *limæ labor* has not been spared." For the convenience of

the learner, a selection for a minimum course of Algebra, such as would ordinarily be advisable, is pointed out, and also a more extended course, such as is requisite for the prosecution of the higher mathematics; while the rest, the author states, may very well be reserved for reference, as the student's own discovery of his wants in the advanced stages of his mathematical pursuit shall call it into requisition.

11. *Organic Remains.*—Prof. BRONN of the University of Heidelberg, Germany, has in the press a systematical and geological catalogue of all fossilized organic bodies. The vegetables and zoophytes fill thirteen sheets (feuilles d'impression) closely printed, and include nearly 6000 species. The MS. for the nomenclature belonging to this part has also gone to press, and it is expected that the whole will be finished in about ten months from Oct. 23d, 1846, the date of a letter from the author.

12. *The Literary World: a Gazette for Authors, Readers and Publishers.* New York. No. I. Feb. 6, 1847. 24 pp. 4to. $3 per annum. —A new weekly Journal of superior character, recommending itself to all, scientific as well as literary, for its early announcements, registers, and reviews, of recent publications, foreign and domestic, and for its book advertisements from various houses of New York city and elsewhere.

D. P. GARDNER, M. D.: The Chemical Principles of the Rotation of Crops, pronounced before the American Agricultural Association, March 4, 1846. 29 pp. 4to, from the Transactions of the American Agricultural Association. 1846.

D. D. OWEN, M. D., and J. G. NORWOOD, M. D.: Researches among the Protozoic and Carboniferous rocks of Central Kentucky, made during the summer of 1846. 12 pp. 8vo., with a lithographic plate of fossils. *St. Louis.* 1847.

HENRY COLMAN: European Agriculture and Rural Economy, from Personal Observation; vol. ii, part viii. *Boston*, 1847.

Naturalist's Library, People's Edition, vol. xvi, Mammalia, Lions, Tigers, &c. 12mo. *London*, 1846. 4*s.* 6*d.*

I. I. GRIFFIN: Chemical Recreations, new ed., 18mo. *London*, 1846. 7*s.* 6*d.*

W. WHEWELL: History of the Inductive Sciences, 2d ed. *London*, 1846. 2*l.* 2*s.*

G. B. SOWERBY, F. L. S.: The Recent Brachiopoda, from the 6th and 7th parts of the Thesaurus Conchyliorum, with 7 colored plates. *London*, 1847. 15*s.*

Dr. C. G. SIEBEL: Palāozoologie; 23 sheets large 8vo. *Merseburg*, 1846. 1½ *Thlr.*

Wir leben in der Natur und müssen sie kennen; freie Unterhaltungen über vaterländische Natur und deren Diener mit Physiophilus; Erstes Bändchen. *Berlin*, 1846. 15*sgr.*

ARCANGELO SCACCHI: Lezioni di Geologia; 178 pp. 8vo, *Naples*, 1843.

———, Quadri Cristallografici e Distribuzione Sistematica dei Minerali; 70 pp. 8vo, with two plates. *Naples*, 1842.

HOMBRON ET JACQUINOT: Voyage au pôle sud et dans l'Océanie, sur les corvettes l'Astrolabe et Zelée, sous le commandement de M. Dumont Durville. Zoologie. Tomes i et ii, in 8vo. *Paris.*

R. D'HERICOURT: Second voyage sur les deux rives de la Mer Rouge, dans le pays des Adels et le Royaume de Choa. *Paris.* 1 vol. 8vo.

FREDERIK KLEE: Le Déluge; Considerations Géologiques et Historiques sur les derniers Cataclysmes du Globe. 1 vol. 18mo. *Copenhagen*, and *Paris.* 3*fr.* 50*c.*

P. JOIGNEAUX: Traité de Chimie Agricole. 1 vol. 12mo. *Paris*, 1846. 4*fr.*

Descriptions of the New Shells of the Exploring Expedition under Charles Wilkes, U. S. N., by A. A. Gould, M. D.; continued. (From the Proceedings of the Boston Society of Natural History.) One sheet containing 4 species of Helix, 6 of Vitrina, 16 of Succinea, and 7 of Bulimus.

PROCEEDINGS OF THE AMERICAN ACADEMY OF ARTS AND SCIENCES, BOSTON, August, 1846.—p. 5. Moon culminations, observed at Cambridge Observatory, from Oct. 20, 1844, to June 14, 1846; *W. C. Bond.*—p. 14. Observations on the Transit of Mercury, May 8, 1845; *W. C. Bond.*—p. 17. Observations on the Comets of 1845 and 1846; *W. C. Bond.*—p. 19. Observations on the Solar Eclipse of May, 1845; *W. C. Bond.*—On the Solar Eclipse of April, 1846; *W. C. Bond.*—p. 21. Notes on Meteors, mostly of August, 1845 and 1846; *W. C. Bond.*—p. 23.

Observations on Phonotypy; *Emerson.*—p. 39. On De Vico's Fourth Comet; *Prof. Pierce.*—p. 44. Meteorological register kept at St. Michael's; *J. C. Hunt.*—p. 46. New genera and species of Compositæ; *Prof. A. Gray.* (This Journal, p. 274)

PHILOSOPHICAL TRANSACTIONS OF THE ROY. SOC. OF LONDON, 1846. Part 2.—On the Blood Corpuscle; *T. W. Jones.*—On a point connected with the dispute between Keil and Leibnitz, about the invention of Fluxions; *A. de Morgan.*—On the action of the Rays of the Spectrum on Vegetable Juices; *Mrs. M. Somerville.*—On the use of the Barometric Thermometer for the Determination of Relative heights; *J. R. Christie.*—Investigation of an Extensive Class of Partial Differential Equations of the 2nd order; *G. W. Hearn.*—On Spontaneous Nitrification; *C. F. Schönbein.*—On the Viscous Theory of Glacier Motion; *J. D. Forbes.*—On the Nervous Ganglia of the Uterus; *R. Lee.*—On the Nerves of the Uterus; *T. S. Beck.* Part III. Contributions to Terrestrial Magnetism; *Lieut. Col. E. Sabine.*—Meteorological Observations made on board the Bark Pagoda, in 1845, between 20° and 63° S. Lat., and 0° and 120° E. Longitude; *Lieut. H. Clerk.*

LONDON JOURNAL OF BOTANY, for *December*, 1846.—Memoir of the life of Dr. J. R. Vogel.—Sur le genre Godoya et ses analogues; *Dr. Planchon.*—Botanical Information, viz: Letter of Dr. Leichkardt, from New Holland; Notice of Bloxam's British Rubi; Tomb of the Botanist Allan Cunningham, with a plate.

MEMOIRS OF THE GEOLOGICAL SOCIETY OF FRANCE, 2d Ser., 2d part of vol. i.—On the geology of the vicinity of Bayonne; *Thorent.*—Fossil Entomostraca of the cretaceous strata of La Haute Marne; *J. Cornuel.*—Journal of a Voyage in Turkey; *A. Viquesnel.*—Geology of the Mountains between the route of the Simplon and that of St. Gothard; *Studer.*—On the nummulite deposit of Les Corbières, and La Montagne Noire; *Leymerie.*

ANNALES DES SCIENCES NATURELLES. *July*, 1846.—On the embryogeny of the Gasteropodous Molluscs; *C. Vogt.*—On the successive development of the vegetable matter in the culture of wheat; *Boussingault.*—Note on the family of the Penæaceæ; *A. de Jussieu.*—Note on the Hypopitys multiflora, *Scop.*; *P. Duchartre.*—Extract of a Memoir on the nature and causes of the Potatoe disease in 1845; *P. Harting.*—Thirteenth notice on the Cryptogamous plants recently discovered in France; *J. B. H. J. Desmazières.*

August.—On the embryogeny of the Gasteropodous Molluscs (continued); *C. Vogt.*—On the development of the tissues in the Batrachians; *Kælliker.*—On the movements of the heart; *de Martino.*—On the generation and development of the Biphori (Salpa); *Krohn.*—Hemipsilus, a new genus of Annelida; *de Quatrefages.*—Thirteenth notice on the Cryptogamous plants recently discovered in France; *J. B. H. J. Desmazières.*—On the motion of the sap in the interior of cellules; *Hugo Mohl.*—Monograph of the genus Pentarhaphia, and a new genus of the family Gesneriaceæ; *J. Decaisne.*—Flora of Sumatra; *W. H. de Vriese.*—On the Vanilla; *Desvaux.*—Description of a new genus of plants near Cliftonia, and observations on the affinities of Saurauja, Sarracenia and Stachyurus; *J. E. Planchon.*

COMPTES RENDUS; xxii, *Oct.* 12, 1846.—On a meteor of March 21, 1846, and calculations of its distance, &c.; *M. Petit.*—Human bones in Algiers in ancient tombs of unknown origin; *M. Serres.*—On the composition of the salts of antimony; *M. Peligot.* *Oct.* 19.—Comparison of observations on the new planet with the theory deduced from the perturbations of Uranus; *Le Verrier.* *Oct.* 26.—Physiological action of chlorid, bromid, and iodid of potassium; *Bouchardat* and *Stuart Cooper.*—New combinations of cyanid of mercury; *Poggiale.*—On the conversion of sulphuretted hydrogen into sulphuric acid; *Dumas.*—On the law of compressibility of elastic fluids; *Regnault.*—On xyloidine; *Pelouze.* On Isomeromorphism; *A. Laurent.*—Arsenic in mineral waters; *Figuier.* *Nov.* 2.—On the compressibility of liquids, and especially of mercury; *Regnault.*—On xyloidine; *Pelouze.* *Nov.* 9.—On xyloidine; *Pelouze.*—On the projectile force of gun-cotton; *Merin.* *Nov.* 16.—On xyloidine and pyroxyline; *Pelouze.*—On gun-cotton; *Riobert, Payen, Seguier, Clerget, Combes* and *Flandin.*—On the temperature of the Geysers of Iceland; *Descloiseaux* and *Bunsen.*

PROCEEDINGS (BERICHT, &c.) OF THE BERLIN ACADEMY, Aug. 1846.—Description on new genus of Mammifera from Mozambique; *Peters.*—On the daily change of temperature of the atmosphere; *Dove.*

ARCHIV FÜR NATURGESCHICHTE, W. F. ERICHSON. No. 3, for 1846.—On the structure and relations of the Polygastric animalcules, &c.: *C. Eckhard.*—Development of the Limnæus stagnalis, ovatus and palustris; *A. F. F. Karsch.*—On the Geographical Botany of Texas; *F. Lindheimer.*—On the genus Oncodes; *W. F. Erichson.*—Review of the Works on Physiological Botany for the years 1844, 1845, (concluded); *H. F. Link.*